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THE COST OF PRODUCING APPLES IN HOOD RIVER VALLEY.[1]

A Detailed Study, Made in 1915, of the Current-Cost Factors Involved in the Maintenance of Orchards and the Handling of the Crop on 54 Farms.

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During the summer of 1915 an investigation was conducted with reference to the factors entering into the annual cost of producing apples in the Hood River Valley of Oregon (see fig. 1) up to the point of delivery at the shipping station. On account of orchards being of varying ages, and operated in some instances by absentee owners, it was difficult in many cases to secure accurate data.

However, 54 complete and detailed records of orchards were secured. All these were obtained from growers who supervised their own orchards and who were able and willing to give complete information.

The purpose of this investigation was not only to arrive at the annual cost of production, but to determine the economic status of

[1] This is the third of a series of bulletins on the cost of apple production. Department Bulletin No. 446, "The Cost of Producing Apples in Wenatchee Valley, Washington," and Department Bulletin No. 500, "The Cost of Producing Apples in Western Colorado," have already been published.

Note.—Acknowledgment is due to the Office of Horticultural and Pomological Investigations of the Bureau of Plant Industry for material assistance in the preparation of this bulletin; also to Mr. J. Clifford Folger, who aided in securing the necessary data.

the apple industry in the valley and the general farm-management conditions prevailing in the region.

The method of investigation was to question the grower on all items of labor and materials used, system of management, yield, and every other factor affecting the annual cost of operating an orchard. Throughout this entire bulletin the acre is the unit used, thus giving each record or orchard the same weight in the final averages.

Four kinds of costs are considered in arriving at the total annual cost of production: (1) Maintenance, (2) handling, (3) material, and (4) fixed charges.

Labor costs.		Costs other than labor.	
Maintenance.	Handling.	Material.	Fixed.
Manuring. Pruning. Disposal of brush. Plowing. Cultivating. Sowing mulch crop. Handling mulch crop. Propping. Thinning. Spraying. Miscellaneous.	Picking. Hauling shooks. Hauling to packing house. Packing. Sorting. Waiting. Foreman. Nailing. Haul to station.	Manure. Lime-sulphur. Lead. Bordeaux, $CuSO_4$. Box. Nails. Paper.	Taxes. Insurance. Equipment charge. Apple-house depreciation. Interest. Water rent.

FACTS BROUGHT OUT.

Total costs.—It is found that the total cost of apple production for 54 bearing orchards, representing the commercial and well-cared-for orchards of Hood River Valley, is $1.02 per box. Costs per acre are $222.83 for orchards under clean cultivation and $232.32 under mulch crops. (See Table I.)

Analysis of costs.—The cost per box, exclusive of interest on orchard-land investment, is $0.68 for clean-cultivated orchards and $0.645 for orchards in mulch crops or irrigated, or $0.664 for all orchards.

Net labor costs for all records average $0.383 per box, or 37.5 per cent of total cost (17.6 per cent is for maintenance and 19.9 per cent for handling).

Costs other than labor, including all material and fixed costs, constitute 62.5 per cent of the total cost (18.9 per cent for material and 43.6 for fixed charges). The fixed cost is nearly 70 per cent of all costs other than labor. Interest on orchard-land investment alone is $79.26 per acre, or $0.357 per box—approximately 35 per cent of the total cost of production.

The cost per box (labor, material, and fixed charges) up to the time when the apples are ready to harvest from the trees is $0.676, while the cost of labor and material for harvesting is $0.345. The

total labor and material cost for harvesting is 33.77 per cent of the total of all costs.

Credits.—Cull fruit pays a net annual cash credit of $4.06 per acre (gross $5.13, less $1.97 per acre for extra labor on culls).

Twenty-four mulch-crop orchards show an average annual credit of $6.18 per acre for hay (gross $9.59 per acre, cost of harvesting $3.41).

Size and type of farms.—The 54 farms studied average 39.45 acres in size, with 69 per cent of the farm area tillable. Apples and strawberries are the staple fruits. Considerable quantities of alfalfa and of timothy are grown and a small acreage of grain.

The orchards.—The orchards studied average 12.4 acres in size, 12 years of age, and 72 trees to the acre. Apple orchards constitute 32 per cent of the total farm acreage. Yellow Newtown and Esopus are grown, practically to the exclusion of other varieties.

Investments.—Total investment per farm is $23,487.36; per acre of apple orchard, $990.74.

Orchard management.—Thirty of the 54 growers practice clean cultivation, while 24 use mulch crops, usually in the form of alfalfa or clover. In general the clean-cultivated orchards are not as yet irrigated, while all the mulch-crop or shade-crop orchards are under irrigation.

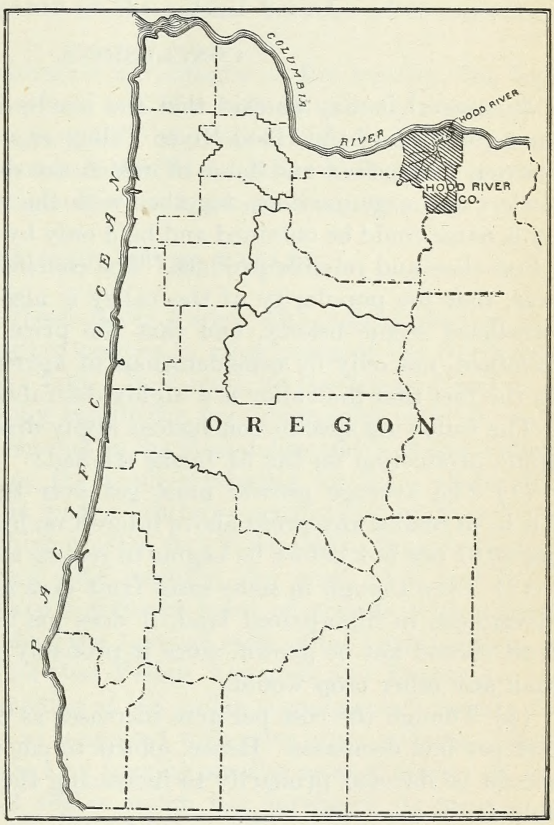

FIG. 1.—Map of western Oregon showing the location of Hood River Valley where the investigation was made. The shaded area is Hood River County.

Yield.—The average yield, all records, is 222 boxes per acre; for clean-cultivated orchards, 218; for mulch-crop orchards, 228. This refers to packed boxes of marketable fruit only.

TABLE I.—*Summary of costs after crediting orchard with hay and culls.*

Item.	Clean cultural (30 records).			Mulch crop or shade crop (24 records).			All records (54).			
	Cost per acre.	Cost per box.	Per cent of total.	Cost per acre.	Cost per box.	Per cent of total.	Cost per acre.	Cost per tree.	Cost per box.	Per cent of total.
Maintenance	$43.63	$0.2001	19.58	$35.41	$0.1554	15.25	$39.97	$0.555	$0.1801	17.63
Handling	44.15	.2025	19.81	46.27	.2029	19.91	45.08	.626	.2031	19.88
Material	41.12	.1886	18.46	45.06	.1976	19.40	42.80	.594	.1927	18.86
Fixed	93.93	.4309	42.15	105.58	.4632	45.44	99.11	1.376	.4458	43.63
Total	222.83	1.0221	100.00	232.32	1.0191	100.00	226.96	3.151	1.0217	100.00

CONCLUSIONS.

In general it may be said that the results of this study bear out the reputation of the Hood River Valley as a very progressive fruit district, the success and fame of which are due to the efforts of its settlers and organizations, together with the realization that a good trade name could be obtained and held only by putting on the market a first-class and reliable product. The conclusion is inevitable, however, that the popularity of the valley is also due to its almost unparalleled scenic beauty, and that the price of land has been determined, not only by considerations of agricultural value, but also by the fact that the valley is a highly desirable place of residence.

The following specific conclusions apply directly to the business of apple production on the 54 farms studied:

(1) The average grower must get over $1 per box for apples, f. o. b., to realize any profit above interest on his investment, and must get $0.67 per box before he begins to realize any interest.

(2) Even though in some cases fruit does not pay full interest on investment in high-priced land, it does not necessarily follow that fruit should not be grown, since it probably pays a higher interest than any other crop would.

(3) Though the cost per acre increases as the yield increases, the cost per box decreases. Hence, efforts to cut the cost of production should be devoted primarily to increasing the acre yield of marketable fruit.

(4) Investment and fixed costs are as high per acre where the yield is small as where it is large. Thus, a yield of 200 boxes per acre costs 100 per cent more per box for fixed costs than a yield of 400 boxes.

(5) Farms in the valley are, in general, over-specialized. In many cases it is now almost impossible to diversify enough to insure the production of a fair proportion of the farm products consumed on the farm.

(6) Though the average yield of the valley is lower than that of some other sections, the region studied, however, produces apples of the very highest quality.

(7) The valley is particularly well adapted to the production of Yellow Newtown and Esopus, both of which grow to perfection here.

These conclusions, of course, apply to the 54 farms studied in the valley. Individual growers often obtain much better results than those indicated by the averages here presented; indeed, in some years exceptional yields run as high as 1,000 boxes per acre. It is believed, however, that the averages derived from the records of the 54 farms studied are a fair measure of the normal business of the apple industry of the valley.

Considering the residential advantages of the locality, the high grade of the fruit shipped, and the valley's already long established reputation for high quality of product and reliability of pack, it seems reasonable to conclude that Hood River Valley will continue to occupy an important place in the apple-growing industry.

THE HOOD RIVER VALLEY.

For several reasons Hood River Valley, although studied in connection with apple-growing regions in other parts of the Northwest, should be discussed as a unit. It is more or less isolated and is of limited extent, presenting conditions not comparable with those of such apple-producing regions as the Wenatchee and Yakima Valleys in Washington State or the apple-producing localities of western Colorado. It is a region with a rainfall equaling that of New York. It thus has a climate which is often very favorable to fungus troubles. It has not been irrigated until recently, and much of it is still unirrigated. The trees have a different habit of growth, with a lower average annual yield, than the trees of most other apple sections of the Northwest. The fact that Yellow Newtown and Esopus are the leading commercial varieties of the valley accounts very largely for the lower average yield as compared with some other sections. These varieties are characterized by bearing smaller annual crops. It is a highly specialized fruit region which has developed its own name, its own methods, and determined its own success. In many respects it is entirely different from other important apple-growing districts.

LOCATION AND EXTENT.

The Hood River Valley is a limited area, 80 miles east of Portland, Oreg., on the south side of the Columbia River.

The Hood River rises at the foot of Mount Hood and flows for about 30 miles north into the Columbia River, the town of Hood

River being located at its mouth. (See fig. 2.) The valley is narrow, varying from 2 to 8 miles in width, and the cultivated area extends from the town of Hood River to Parkdale in the upper valley, a distance of about 24 miles. It is divided into what are known locally as the lower, middle, and upper valleys. The lower valley contains the most bearing fruit and the greatest percentage of tillable land. The middle valley is considerably less intensive in

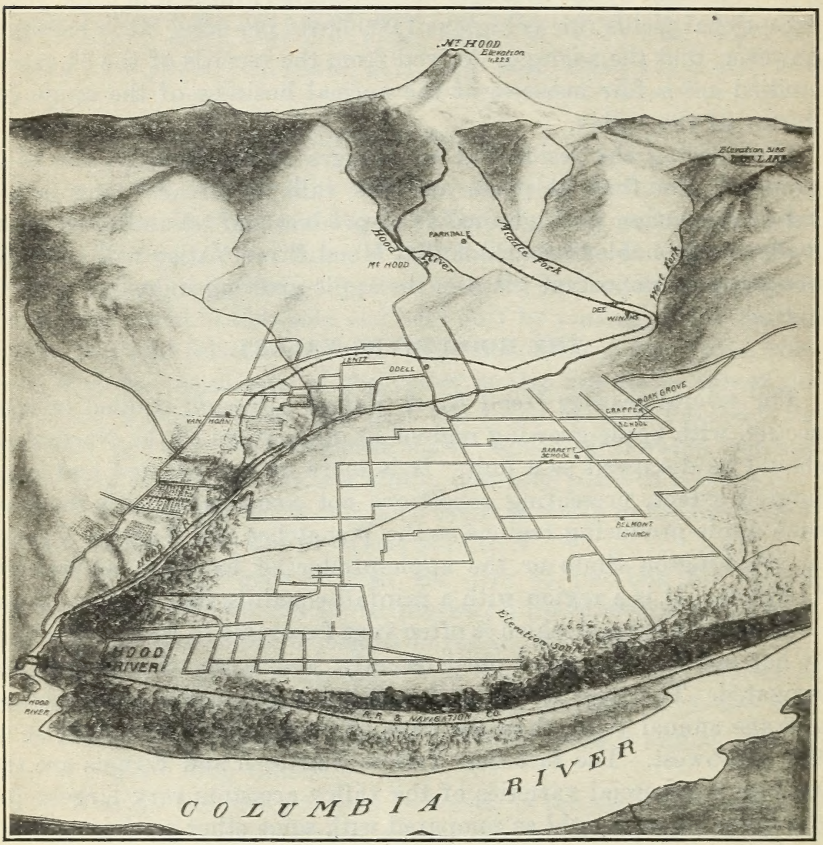

FIG. 2.—A topographical sketch of Hood River Valley, looking south from the north bank of the Columbia River.

its agriculture, being to some extent devoted to general farming, while the upper valley is as yet little cleared, the small settlements being scattered and separated by areas heavily wooded with pine.

The Hood River divides the valley into what is known as the east side and the west side. The east side is the more developed and intensive. It is of a less rocky nature and seems better adapted to fruit. The best bearing apple orchards are now found on the east side, which is much narrower than the west side, but the cultivated area

of which extends much farther up the valley. More general farming is found on the west side, and less detailed care is given the orchards there. The Oak Grove district, a large district on the west side, has many beautiful homes of people who have ranches for pleasure as well as for profit.

Pine groves and trees are numerous, and add greatly to the natural charm of the region. Mount Hood to the south and Mount Adams to the north, both beautiful mountains and continually capped with snow, add a crowning touch of grandeur to the landscape that has made this valley famous for its natural beauty. (See plates I and II.)

Hood River is a fast-flowing stream; it is really a mountain brook. (See Pl. III.) There are no broad, level, flat lands that one thinks of as characterizing a river valley. The orchards are located on the benches and rolling land between the stream bed and the mountains on each side. The topography is extremely varied, and is a combination of buttes, slopes, rolling hills, and fairly level fields, often cut up with little creeks. The areas of level ground are very limited in extent.

COMMERCIAL IMPORTANCE OF HOOD RIVER.

The popularity and commercial importance of Hood River are based not so much on the quantity of fruit shipped, as on its quality, and the dependence the trade has learned to place in Hood River apples. The apples of Hood River are largely limited to two very important commercial varieties which grow to perfection here. These varieties are Yellow Newtown and Esopus.

According to the census figures, there are 60,345 acres of tillable and 62,598 acres of nontillable land in Hood River County. Of the tillable area 13,446 acres, or 22 per cent, are in apple orchards, and of this amount there are 2,665 acres, or about 20 per cent, in trees 10 years of age or over. Seven hundred and fifty cars of apples were shipped out of the Hood River Valley district in 1911, 1,100 cars in 1912, 1,050 cars in 1913, and 1,200 in 1914, or an average of about 1,000 cars per year. The usual number of packed boxes per car is 630.

AGRICULTURAL DEVELOPMENT.

The first settlers in the valley occupied mainly the narrow strip of alluvial soil along the Columbia River and the more level parts of the valley above. The isolation of the valley retarded its development, and the lack of market, together with the fact that all produce had to be shipped by boat on the Columbia River, limited the agricultural activities almost exclusively to stock raising. The

early farming was confined principally to those areas where there was little or no timber. The valley was for the most part heavily timbered, particularly on the east side. For many years the only work done in clearing was on the small tracts around the settlers' cabins, which supplied all the land necessary for agricultural purposes until markets became available.

The first orchard in the valley was planted about 1875, on the west side, but none of commercial importance was planted before 1890. From this time on the plantings increased, the maximum amount of planting being done between 1902 and 1909. During the last few years plantings have largely ceased.

The west side having a sandy soil, it was thought for many years to be the only part of the valley suitable for profitable fruit growing. At the present time it is the principal strawberry-producing section. The more sandy soils of the valley seem particularly adapted to strawberries, and the strawberry industry held an important place in the agriculture of the valley long before the apple became dominant. On account of the higher altitude the upper-valley strawberries ripen much later than those of the lower valley, thus giving the district a long marketing season.

Apples have been planted almost to the exclusion of other orchard fruits. The land on the east side was developed later than that on the west side, but when it was found that the land on the east side was well adapted to apples it was rapidly bought up in small tracts, cleared, and set out to orchard. The east side has now considerably more orchard area than the west side, the farming being more intensive, and devoted more largely to commercial fruit production. (See Pl. IV.) The more recent settlers confined their attention almost wholly to fruit farming. As the demand for land increased the price rose very materially. To avoid these high prices the newer settlers often located on the slopes, in many cases above the irrigation canal, and in the upper Hood River Valley, where the land as yet is little cleared.

Recent development of transportation facilities has contributed to the valley's rapid development.

SOIL.

The Hood River Valley is located within the area of an important rock formation known as the Columbia lava. Thus, the soil of the valley is in general of volcanic origin, modified by glacial action.

The commercial orchards of the lower valley are for the most part located on the Hood silt loam type of soil. The Hood silt loam is generally of a light gray color. The silt content is low and it often approaches a sandy loam in texture. This soil covers the greater

VIEW OF THE VAN HORN BUTTE, FAMOUS AS A BEAUTIFUL RESIDENTIAL SPOT, WITH MOUNT HOOD 25 MILES AWAY IN THE DISTANCE.

The natural beauty of Hood River has added greatly to its popularity and brought many desirable settlers. Land in this immediate region is valued at $1,000 or more per acre.

LOOKING ACROSS HOOD RIVER FROM THE PETER'S RANCH, ON THE EAST SIDE OF THE LOWER VALLEY.

The most intensive apple section of the region. The orchard in the foreground is an 80-acre block just coming into bearing, one of the best managed in the valley.

VIEW UP THE HOOD RIVER VALLEY FROM A POINT ON THE EAST SIDE 6 MILES ABOVE THE TOWN OF HOOD RIVER, SHOWING THE NARROW CREEK BED AND THE UNEVEN TOPOGRAPHY.

View Across the Lower Valley from the Main Highway on the East Side, Showing a Packing House and Clean Cultivated Orchard in the Foreground.

part of the lower valley between Hood River and the range of mountains along the eastern boundary of the area as far up as Odell. On this area is located the largest and most intensive apple section of the valley. The drainage is generally good.

The soil of the Underwood loam covers the largest areas of the valley, in fact, more than all other types combined. It occurs on the slopes of the mountains in and about the valley. The soils of the middle valley are almost entirely of this type. It is a residual soil, derived from the weathering of the underlying basalt. Its value for agricultural purposes varies according to the topography. With the exception of the steeper slopes the parts which are cleared are used for the production of apples and strawberries.

Many other types of soil are found in the valley. The Parkdale loam covers most of the upper valley. It is probably derived from weathered ice-laid material.

On the west side of Hood River Valley the soils are of the Wind River types, varying from a strong loam to a fine sandy loam. Because of their coarse nature, these soils are rather excessively drained. They need irrigation and are in general more difficult to cultivate than the prevailing types found on the east side of the river. Of all these types the Hood silt loam apparently is the best adapted to apple culture.[1]

CLIMATE.

Hood River is located to the east of the main range of the Cascade Mountains, but in a region of moderately abundant rainfall. It is characterized by moderate winters, with frequent heavy snowfalls, long, rather cool summers, and comparative freedom from damaging frosts. The rainfall, which is approximately 35 inches per year, is equal to that of the apple-growing sections of New York or Missouri, but owing to the fact that there is a rainy and a dry season, it is often desirable to resort to irrigation, which is now becoming a general practice. Destructive storms seldom occur, and damage from hail or storms is infrequent.

Because of the irregular topography there is a marked difference in temperature and precipitation between the different sections of the valley. The number of clear days is considerably greater in the lower than in the upper valley. The length of season may vary a month between the town of Hood River and the town of Parkdale, located in the upper valley about 24 miles to the south. Climato-

[1] U. S. Dept. of Agr., Bureau of Soils, Field Operations 1912, Soil Survey of the Hood River-White Salmon River Area, Oregon-Washington, by A. T. Strahorn and E. B. Watson.

logical records give the average date of the last killing spring frost for the past 15 years in Hood River as April 22. For the same period the average date of the first killing frost in the fall was near October 14. This gives an average of 175 growing days. The mean annual temperature is 50.1° F. This, it should be remembered, is for the lower valley, near the town of Hood River.

Mist-like rains occur frequently during the early summer months. As a result fungus troubles, particularly apple scab, are serious and necessitate a relatively large amount of spraying.

The prevailing winds are from the west. In general, they follow the Columbia River gorge from the coast, thus tending to maintain fairly cool temperatures during the summer season and preventing extreme cold during the winter.

Truck and forage crops naturally adapted to a fairly cool temperate climate succeed well here, provided suitable soil is chosen.

TRANSPORTATION.

The town of Hood River is located on the main line of the Oregon-Washington Railroad & Navigation Co., which gives it easy access to Portland, about 80 miles distant, and also furnishes an outlet to eastern points. There is a local railroad line, known as the Mount Hood Railroad, which traverses the Hood River Valley, connecting the town of Hood River with Parkdale in the upper valley. There are several important fruit-loading stations on this line, including Van Horn and Odell. Transportation by boat on the Columbia River is also available. This was formerly the only means of transportation.

RURAL SOCIAL CONDITIONS.

There are few rural communities where better social conditions exist than in Hood River Valley. The people are for the most part well educated. The excellent schools and churches, the means of recreation, and the systems of telephones and of rural mail delivery which prevail throughout the valley provide advantages as yet unavailable in the average rural community. The homes of Hood River are more elaborate and expensive than the average farmhouse, much of the money invested in them having been made through outside sources. (See fig. 3.) The ranch houses are near together. Indeed, in the lower valley, especially on the west side, they are almost a part of the town itself as regards conveniences. As yet the people in the upper valley are somewhat isolated.

LABOR CONDITIONS.

There is little complaint with regard to labor conditions in this section. The rates paid are not quite as high as in some other North-

west sections. Both whites and Japanese are employed. White help, employed by the month, receives wages varying from $25 to $40 per month with board, or $40 to $60 per month without board. Much of the orchard work is done with day labor at 20 to 25 cents per hour. Japanese labor is cheaper, costing 17½ cents per hour, and is used largely for strawberries. Growers say the Japanese are good laborers if a white foreman superintends. Except as house servants, Japanese are rarely employed by the month.

On the 54 orchards taken into account in this investigation the average rate paid for all kinds of labor for the past few years was

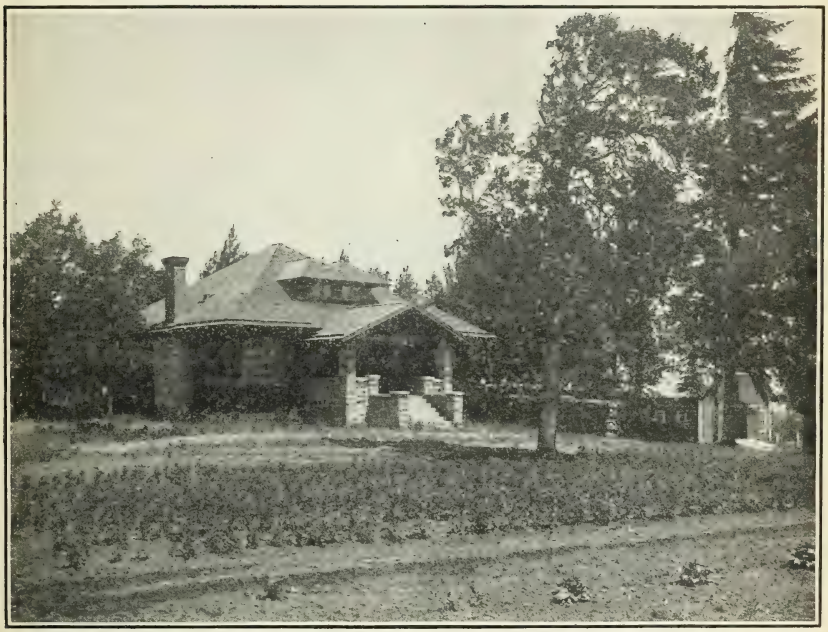

FIG. 3.—One of the many bungalow homes found in the rural districts of the valley.

22½ cents per hour, or at the rate of $2.25 per day. Month labor usually is fully as expensive per hour in this region as day labor, for it often occurs that little productive labor is done on certain days where a man is employed by the month. In order to make the records comparable the average rate of 22½ cents per hour is used on all the farms.

An operator's time is charged at the same rate as the men he employs. If he were paid for his managerial ability each operator would receive a different wage; for all practical purposes it is best to figure all man-hours at the same rate. Horse labor is figured at the rate of 15 cents per hour.

FARM ORGANIZATION.

The farms or ranches in Hood River Valley are primarily specialized fruit farms. Other crops are grown mainly or exclusively for home use. These include hay for the horses and garden truck for the use of the farm family. Strawberries work in well with apples and are grown extensively as a cash crop, particularly on the west side of the valley. On account of the small size of the farms and the consequent necessity for intensive operation, together with the high value of the land for fruit culture, it is hardly practicable for growers to follow a diversified system of farming beyond the point of raising feed for the stock kept, and potatoes, garden vegetables, etc., for home use.

Furthermore, the limited area of the valley makes it practically impossible to expand, particularly in the lower valley. Farms have been bought, settled, developed, and organized with fruit as the main, and often the only, source of income. This is particularly true on the east side of the lower valley, where this investigation was made. Because of the natural limitations and the topographical features of the valley, the ranchers do not have easy access to any extended area for general farming purposes. Hence the agriculture of the valley is specialized, and will no doubt remain so, with the farm probably furnishing the greater share of the products required for use on the farm. These conditions make the growers almost wholly dependent on their income from fruit.

TYPE OF FARMS INCLUDED IN SURVEY.

The 54 farms included in this survey are all located on the east side of Hood River and all on the Hood River silt loam soil, with the exception of a very few on the Underwood loam of the middle valley. They range in size from 10 to 150 acres and average 39.4 acres, 69 per cent of which acreage is tillable.

The average size of bearing apple orchard on these farms is 12.4 acres, with an average young apple orchard of 6.24 acres. These farms are typical of the commercial apple district of Hood River Valley and represent the conditions of full-bearing orchards as they exist in the lower valley to-day. Nearly all are intensive and apples are the chief source of income.

TYPE OF GROWER.

Many of these farms are operated by men who came from other walks of life. Several of the growers are college graduates. There are also among them many professional men and tradesmen who chose fruit growing as an occupation after retiring from their pro-

fessions or trades. The larger farms are usually owned by the pioneers of the valley. These are usually men with considerable agricultural experience. In some cases, however, the man from the city who applies thorough business methods is more successful than his more experienced neighbor.

INVESTMENT.

In Hood River Valley on the 54 farms studied the average investment per farm as estimated by owners is $22,503.70, the average size of farm being practically 40 acres. The average investment per acre

FIG. 4.—A typical ranch 2 miles west of Odell, showing an orchard in bearing and a young orchard planted on land recently cleared of pine. This land was valued at about $250 per acre before it was cleared.

in apple orchards is $990.70. As shown in Table II, the investment is somewhat higher for mulch-crop than for clean-culture orchards. This is due to the fact that those under the mulch-crop system are all irrigated and generally better located than those still under the clean-culture system.

An investment of nearly $1,000 per acre is easily accounted for when all the existing factors which have influenced the price of land are considered. The original raw land suitable for orchard purposes, when fairly well located, sells for $200 to $250 per acre. (See fig. 4.) The cost of clearing this land, which is heavily wooded, usually with pine, is from $90 to $150 per acre.

TABLE II.—*Statistical summary of the 54 apple orchards studied in Hood River Valley.*

Item.	Clean cultural.	Mulch crop.	All records.
Number of records	30	24	54
Acreage per farm:			
Total	44.22	33.50	39.45
In bearing apple orchard	12.25	12.70	12.45
Per cent in bearing apple orchard [1]	39.45	55.03	46.38
Investment per farm:			
Total	$24,704.09	$21,966.44	$23,487.36
Land and improvement	23,673.33	21,041.67	22,503.70
Working capital	1,148.76	1,053.65	1,106.49
Equipment	528.03	446.67	491.87
Horses	349.77	312.50	333.20
Other stock	120.96	154.48	136.04
Investment per acre of bearing apple orchard:			
Total	931.67	1,064.58	990.74
Per cent of total farm investment apple orchard represents	48.93	60.40	54.03
Land and improvement:			
Per cent of total investment in land and improvement apple orchard represents	51.26	63.31	56.61
Equipment	21.51	24.12	22.67
Number of horses per farm	2.33	2.25	2.30

[1] Average of percentage of bearing apple orchard found on each farm.

The price of the raw land throughout the valley was greatly enhanced in the early days by the high prices obtained for fruit. These prices brought many settlers to the valley. The price of land increased with the demand for it, and finally rose to a figure which practically prohibited the man of small means from purchasing land suitable for growing fruit. Men with considerable capital settled in Hood River Valley, attracted largely by the natural beauty of the valley and its advantages as a location for a home. The fact that fruit growing was a thriving business, looked upon as one of the most pleasurable and interesting agricultural pursuits, was of course the principal attraction, but the impressive beauty of the valley was a close second. These unusual attractions determined the price which prospective purchasers could be induced to pay for land.

The price and the actual agricultural value of land are often very different, and they do not bear as close a relation to each other here as is desirable from the standpoint of profit in farming. Hood River Valley, however, is not unique in this respect.

The investment in equipment is high per acre on account of the small size of the average farm in this region. The largest single item of equipment investment is represented by the spraying outfit; 80 per cent of the growers whose records were considered have their own spray rigs. As might be expected, the investment in stock other than horses is small, but is larger on those farms growing mulch crops. They keep more stock because they have the feed for it.

In arriving at interest and depreciation charges no account is taken of investment in dwellings or other buildings not used exclusively for apples. It was not thought fair to charge the orchard with the upkeep or interest on buildings, which often represent an investment far above that of the average farm buildings.

THE ORCHARDS.

SIZE.

The bearing orchards included in this survey vary in size from 3½ acres to 39 acres. In most cases orchards are 10 to 15 acres in size, and the average of all is 12.4 acres. Large farms, as a rule, do not have exceptionaly large orchards. The average farm of 50 acres has as large an orchard as the average farm of 100 acres.

AGE.

The average age of all the orchards considered is 12 years, the youngest being 9 and the oldest 18 years. All these orchards are considered by their owners to be in full bearing. One noticeable characteristic about orchard plantings in this section is the lack of uniformity as regards age. Many planted their orchards over a series of years, so that the number of bearing blocks of uniform age is limited.

TABLE III.—*Size of farms and of orchards studied.*

Item.	Clean cultural.	Mulch crop.	All records.
Average acreage per farm:			
Total	44.22	33.50	39.45
In bearing orchard	12.25	12.70	12.45
In young orchard	7.48	4.69	6.24
Percentage of area tillable	75.75	60.86	69.10
Bearing orchards:			
Average age	12.00	12.00	12.00
Trees per acre	72.00	72.00	72.00

VARIETIES.

The varieties of Hood River Valley apples are principally two—Yellow Newtown and Esopus. The commercial name of the valley has been built up on these apples. Hood River Valley is thus more limited in its number of commercial varieties than any other Northwest section. There are, however, about 75 varieties found in the bearing orchards of the valley. Others of commercial importance are Ortly, Monmouth, Ben Davis, Arkansas Black, Arkansas, Jonathan, Rome Beauty, and Gravenstein. Some of these are often planted as pollenizers. Yellow Newtown and Esopus do not come into full bearing as early as Jonathan, Winesap, Rome Beauty, and most other commercial varieties of the Northwest.

TREES PER ACRE AND METHOD OF SETTING.

The number of trees per acre in these orchards runs very uniform. In the 54 orchards there is an average of 72 trees per acre, and practically all lie between the limits of 60 and 80. There are many

methods of setting trees, but the usual way is to set on the diagonal, 24 by 24, 26 by 26, or 28 by 28 feet. The trees are not often crowded.

CONDITION OF THE ORCHARDS.

The condition of the 54 orchards studied was in general very good. The foliage of some of them, however, was discolored and the trees apparently lacked vigor. Such orchards were usually those under a system of intensive clean cultivation and not irrigated. The orchards considered were well cared for and of a fairly uniform type representative of the commercial bearing orchards of the valley.

YIELDS.

The average yields from these orchards are considerably lower than those of many of the irrigated sections. The average yield for the 54 orchards is 222 packed boxes per acre, or 3.08 boxes per tree. This average covers, in general, a 5-year bearing period. For the 30 clean-culture orchards the yield is 218 packed boxes, and for the orchards with a mulch crop, all of which are irrigated, there is a yield of 228 packed boxes per acre.

TABLE IV.—*Hood River yields.*

Type of orchard.	Number of orchards.	Size of orchard.	Age of orchard.	Trees per acre.	Yields per acre.	Yield per tree.
		Acres.			*Boxes.*	*Boxes.*
Clean cultivated	30	12.25	12	72	218	3.03
Mulch crop	24	12.70	12	72	228	3.17
All orchards	54	12.45	12	72	222	3.08

The size of orchard apparently has a marked influence on the acre yield. As will be seen from Table V, the smaller the orchard the larger the yield per acre. As the number of trees per acre is practically the same, regardless of size of orchard, the difference in yield may be credited to the more intensive management of the smaller orchards and the greater care which individual trees receive.

TABLE V.—*Yield, according to size of orchard, on farms studied.*

Type of orchard.	Yield (in boxes) in orchards of each specified size.			
	Under 6 acres.	6 to 10 acres.	11 to 20 acres.	Over 20 acres.
Clean tillage cultivated	262.6	224.2	206.9	190.1
Mulch crop	299.1	232.9	215.0	202.9
All orchards	280.9	227.7	210.7	196.5

As concerns the age of the trees, the orchards show a steady increase in yield up to 10 years, and thenceforward the yield per acre remains practically steady, barring fluctuations according to the season.

Another factor which influences the yield is the variety of fruit. Both Yellow Newtown and Esopus are trees which, comparatively speaking, come into bearing late in life. Soil, condition of tree, insect pests, diseases, pruning, thinning, etc., are other factors which have an influence on the yield of marketable fruit.

The average yield in Hood River Valley may show an increase in the next few years, due to the fact that irrigation and the use of mulch crops are coming into more general use. Mulch crops, when properly handled, add considerable humus to the soil. It can not be said conclusively that the mulch-crop system of management produces a larger yield in all cases, but the mulch-crop and irrigated orchards yielded 10 boxes per acre more than did those in clean cultivation and for the greater part unirrigated. Clean cultivation without the addition of humus of any kind, especially in the orchards without water, tends to deplete the soil. This is shown very conclusively by the condition and health of the trees on those orchards of bearing age which have been intensively cultivated for years without the addition of any plant food in the form of manure or a mulch crop.

MARKETING AND PRICES RECEIVED.

It is not the purpose of this investigation to follow the fruit farther than the loading station, and the costs here given are for the fruit delivered f. o. b. at Hood River station. The net prices which are returned to the grower are usually on this basis, all loading, freight, selling, and association charges being deducted.

The fruit in Hood River Valley has in general been handled by associations or distributing agencies. These may be either cooperative or otherwise, but most of the fruit has been shipped through cooperative organizations. Such organizations usually handle the fruit at a fixed cost per box, this being ordinarily 10 cents, or it may be handled on commission.

Hood River apples reach widely different markets, many of them entering the foreign trade. The grower does not hold the fruit in storage on his place, but it is often stored by the association, the grower being charged a fixed amount per box for storage.

The net prices returned to the grower vary greatly. Extra fancy bring the highest price, followed by the fancy, and then by C grade. It sometimes happens that a grower's returns are greater for lower

grade fruit than for higher grade, there being sometimes a demand for the lower grade which makes its marketing more successful. Ordinarily, however, this is not the case, and the aim of growers is to produce the highest percentage possible of extra fancy fruit.

Because of the fact that Yellow Newtown and Esopus are the principal varieties of the valley, both being of high quality and commanding correspondingly high prices, the average price received has been somewhat in advance of that received in some other sections where a greater proportion of the lower priced varieties are grown. During the last few years prices have varied greatly. The returns received f. o. b. by the growers from whom figures were obtained averaged $1.11 per packed box for the years 1910 to 1914, inclusive. The averages by years are $1.52 for 1910, $1.41 for 1911, $0.77 for 1912, $1.23 for 1913, and $0.63 for 1914.

These variations in price are due to many factors. In years of very large yields the price is correspondingly low, while in years when there is a scarcity of fruit the price is high. In 1912 and 1914 the prices received for northwestern fruit were disastrously low, but the other years have helped to make up a fair average. The annual yields corresponding with the yearly prices were a third greater in 1912 and 1914 over that of the other years mentioned. The average price received was due not to the production in the orchards of the valley, but to the annual production in most apple regions of the country. In 1915 and 1916 good prices were received. It will be seen that the price received per box, averaged for a period of 5 years, is about $0.09 above the cost of production, all annual charges up to the time the fruit is delivered at the station being considered.

ORCHARD MANAGEMENT.

The orchards in Hood River Valley are in general well managed. The typical commercial orchard is run in a businesslike way. There are two distinct systems of management—the clean-cultural system and the shade-crop, or mulch-crop, system. All orchards using mulch crops are irrigated, but only about 27 per cent of the clean-cultural orchards are irrigated. Thus the two general divisions are the clean-cultivated and usually unirrigated, and the mulch-crop or irrigated orchards. There is more total labor connected with the mulch-crop system, but when the orchard is credited for the hay removed the net cost per acre for labor is somewhat less than in the clean-cultural system of management. Under orchard management will be discussed all those items pertaining to the growing and harvesting of the fruit. These items are manuring, pruning, disposal of brush, cultivation, handling mulch or shade crop, irrigating,

propping, thinning, spraying, picking, hauling, sorting, packing, and all incidental labor in any way connected with growing or handling the crop.

MAINTENANCE LABOR.

MANURING.

The practice of applying manure is not general. Of the orchardists interviewed, 65 per cent apply manure to a greater or less extent, but the average amount of stock kept is small and as there are few dairy herds in the neighborhood, the amount of manure available for the orchard is very limited. A few orchardists haul manure from town, but on account of the long haul this is not generally done. The average grower will have about 15 to 20 tons of manure for his entire farm. He does not apply this evenly over his orchard, but puts it where it is most needed. It may all go on one or two acres, but the parts heavily manured probably will not receive another coat for several years. The manure is hauled out usually by one man and a team, using a sled or wagon, during the fall or early spring, or as the manure accumulates. It may be put in piles to be spread later, or spread as hauled out. It is usually worked or harrowed into the soil in the spring; if applied on a mulch crop, it is left until the latter is plowed under. In a few cases commercial fertilizers have been applied, but this is not common, and the growers usually do not believe it pays.

The orchardists using mulch crops do not manure to such an extent as those practicing the clean-culture system. Only 58 per cent of the former apply manure, as compared with 70 per cent of the latter, but those mulch-crop men who do apply manure put on more per acre. The quantity applied per acre averages for all records about 1½ tons, at a cost of $1.34 for labor, or a total cost of $3.56 per acre for labor and material.

PRUNING.

Winter pruning is the general practice in Hood River Valley, although considerable summer pruning is practiced on Esopus trees. Growers try to prune every year, although a great many prune only every other year. In some cases an orchard is pruned only once in three or four years. A few men were found who believed in very little pruning. The orchards during the greater part of their life have been without irrigation, and the trees have not made as rapid growth as those in many irrigated sections.

No particular method of pruning is practiced. It might be said that the open-head system is approached, as contrasted with the center-leader type of pruning. The trees are generally headed low and the branches hang low; thus in many orchards the trees have a

"squatty" appearance. Generally they are set at such a distance and so pruned that there is sufficient light and air. The amount of propping required depends upon the habit of growth and shape of the tree, but thinning and harvesting are facilitated by heading the trees low.

The summer pruning consists usually in tipping the branches. According to the growers, the purpose is to induce more regular bearing and to give the trees a more stocky growth; however, there was not enough evidence to form any definite conclusions in regard to this. Many growers prune heavily one year and lightly the next. The average number of trees a man will prune a day in Hood River Valley, where winter pruning is practiced, is 30. The age of the trees apparently did not to any extent affect the time required, as Table VI will show.

TABLE VI.—*Influence of age on time and cost of pruning on farms studied.*

Age.	Trees pruned in 10 hours.	Hours of man labor per acre.	Cost of pruning.		
			Per acre.	Per tree.	Per box.
8 to 9 years	34	20.54	$4.62	$0.07	$0.0223
10 to 11 years	28	25.14	5.66	.08	.0275
12 to 13 years	29	24.45	5.50	.08	.0252
14 to 15 years	32	24.80	5.58	.07	.0170
17 years and over	32	22.38	5.04	.07	.0236
All records	30	24.36	5.48	.08	.0247

The size of the orhard, like age, has little effect on the time required for pruning. With the orchards arranged in five groups, according to size, is is found in each group to cost practically $0.08 per tree, or $0.025 per box.

Pruning time is influenced by the variety, style, and method of pruning, the system, whether alternate or annual, the amount of propping and thinning the grower may practice, the thrift of the tree, and peculiarities of individual trees. Taking all the orchards together, there was a man-hour charge for pruning of 24.36 hours, or $5.48 per acre. With 72 trees per acre, there is an annual charge of $0.08 per tree, or $0.0247 per box. The cost per box for pruning was practically the same for clean-cultural orchards and those under a mulch-crop system of management, it costing $5.28 per acre, or $0.024 per box, for the former and $5.74 per acre, or $0.025 per box, for the latter.

DISPOSAL OF BRUSH.

Three well-defined methods of disposing of the brush are practiced in this region. One way is to go through the orchard with a one-horse wagon or slip boat, pick up the brush, and haul it to some

convenient place for burning. Another is to gather the brush into piles by hand, or, more commonly, by raking with a horserake or some homemade device, and to haul it out and burn it later. The third method, the one least practiced, is to use a brush burner in the orchard. There are several kinds of patented brush burners, but their use as yet is largely confined to younger orchards, many growers claiming that some injury to the trees has resulted from their use in the bearing orchards. A brush burner is a device which is drawn through the orchard and into which the brush is piled and burned. (See fig. 5.) It is a labor-saving device and may come into more general use if the liability of injurying the trees be overcome.

FIG. 5.—A portable brush burner in use during the summer pruning in the upper Hood River Valley. Such burners are not generally used in the older orchards.

The most common method of brush disposal is the one first mentioned above, in which the brush is gathered and hauled from the orchard in one operation. The abundance of wood for fuel makes it unnecessary to save the trimmings for firewood, as is done in many sections. The annual cost of disposing of the brush is $2.36 per acre, or $0.0106 per box, on the 54 orchards considered.

CULTIVATION AND SOIL MANAGEMENT.

Cultivation, which is the most expensive of all maintenance operations, is practiced to some extent in all of the orchards. Thirty, or 55½ per cent, of the men practice clean cultivation annually and

use no mulch crop, while 24 use mulch crops and cultivate perhaps once in three years, or to some extent in early spring every year.

The practice of sowing the orchards to mulch crops is being adopted rapidly and at the present rate may in a few years become universal, providing sufficient water be available.

Clean cultivation was formerly practiced universally. The tendency to change to the mulch-crop system of management is especially noticeable in the older bearing orchards. This is as may be expected, for the older orchards show the need of humus and plant food.

Commencing with the spring treatment of the soil, plowing is frequently one of the first operations, although more often plowing

FIG. 6.—The disk in use on a clean-cultivated orchard.

is done in the fall. Exactly 50 per cent of the 54 growers practice plowing, the number being about evenly distributed between the clean-cultural and mulch-crop orchards. Those of the former who plow do so usually every year, while the latter plow only when the crop is turned under, or about once in three years. A 12-inch field plow, drawn by two horses, is the common type used, the furrows being from 6 to 8 inches deep midway between the tree rows and 3 to 4 inches deep close to the trees. Fall plowing is practiced most frequently in mulch-crop orchards.

The normal cost of plowing an acre in the cultivated orchards is $2.79 per acre for a man and team plowing 1.88 acres per day. In

the case of mulch-crop orchards, the same crew will plow 1.61 acres per day at a cost of $3.26 per acre.

The orchardists of the lower valley begin to cultivate their orchards during the latter part of March or early in April. Following the plow the cultivating tool first used on the clean-culture orchards is usually the spring-tooth harrow, which puts the soil in good condition for succeeding cultivations. This harrow is run "both ways." In some cases the disk or the light drag harrow may be the first tool used, but in any case the soil is well worked up in the early spring. Following the first cultivation comes either a disk or a spring-tooth, these tools usually alternating with each other a few days apart.

FIG. 7.—A float, or leveler, in use. This implement is commonly used after a thorough cultivation to smooth over the soil and create a fine dust mulch.

(See fig. 6.) After three or four cultivations, a spike-tooth is commonly used. This serves to fine the soil and create a mulch. The ground is then often leveled down with a clod masher or float. (See fig. 7.) This completes the first spring cultivation, which is given as soon as the orchardist can get on the land. Other cultivations follow every few weeks, especially after rain occurs. Beginning about May 15, those who practice clean cultivation go over the ground about once every two weeks until the middle of July. These later harrowings are performed usually with weeders (see fig. 8) or

with spike-tooth harrows. These tools are usually light, the aim being not to cultivate deep, but to keep a mulch on the soil and keep the orchard free from weeds. Each tool is often run "both ways," and frequently is zigzagged to form a "figure eight" about the trees.

Rilling the orchards for irrigation is discussed under "Irrigation," but is charged to cultivating time. In the case of the orchards under mulch crop, the crop is sown usually during the summer and is left down for a varying number of years. It is not necessary to reseed unless the orchard is plowed up and cultivated, thus killing the crop. The practice of turning the mulch crop under annually, common in the East, is not general here. When these orchards are plowed up

FIG. 8.—The common type of weeder used in cultivating. The driver rides, his weight helping to force the knives into the soil. The tips of the branches of the young trees are being sprayed for aphis.

and cultivated, about the same general system is followed as in the case of the orchards which are clean cultivated annually. Orchards in alfalfa usually are disked every spring; sometimes a spring-tooth also is used.

The average time required for the different operations in cultivation was in each instance more in the case of mulch-crop orchards than in those under the clean-culture system. As will be seen in Table VII, the cost of disking an acre once over is about the same for both types of management, but there is a difference of $0.18 per acre in the case of the spring-tooth, $0.03 per acre for the spike-tooth,

$0.25 per acre for the weeder, $0.18 per acre for the light-draft harrow, and $0.06 per acre for the float in favor of the clean-culture system.

TABLE VII.—*Normal time and costs of one cultivation on farms studied.*

Item.	Plow.	Disk.	Spring tooth.	Spike-tooth.	Weeder.	Light draft harrow.	Float.
Clean cultivated orchards:							
Man-hours	5.32	2.28	1.40	0.88	1.13	0.57	1.06
Horse-hours	10.64	4.56	2.80	1.76	2.26	1.14	2.12
Acres per day	1.88	4.39	7.14	11.36	8.85	17.54	9.43
Cost per acre	$2.79	$1.20	$0.74	$0.46	$0.59	$0.30	$0.56
Mulch-crop orchards:							
Man-hours	6.21	2.30	1.76	0.93	1.60	0.92	1.19
Horse-hours	12.42	4.60	3.52	1.86	3.20	1.84	2.38
Acres per day	1.61	4.35	5.68	10.75	6.25	10.87	8.40
Cost per acre	$3.26	$1.21	$0.92	$0.49	$0.84	$0.48	$0.62
All orchards:							
Man-hours	5.74	2.29	1.55	0.91	1.23	0.74	1.14
Horse-hours	11.48	4.58	3.10	1.82	2.46	1.48	2.28
Acres per day	1.74	4.37	6.45	10.99	8.13	13.51	8.77
Cost per acre	$3.01	$1.20	$0.81	$0.48	$0.65	$0.39	$0.60

Table VII serves to show normal times for the different kinds of tools of standard make and width. It was found that the average annual cost of cultivation, including plowing, is $11.74 in the case of the clean-culture orchards and $4.44 in the case of the mulch-crop orchards, which receive a thorough cultivation about once every three years.

TABLE VIII.—*Total cultivation costs for all records.*

Item.	Clean culture.		Mulch crop.		All records.	
	Per acre.	Per box.	Per acre.	Per box.	Per acre.	Per box.
Plowing	$1.10	$0.005	$0.70	$0.0031	$0.92	$0.0041
Other cultivation	10.64	.0488	3.74	.0164	7.57	.0341
All cultivation	11.74	.0538	4.44	.0195	8.49	.0381

As is shown in Table VIII, there is a difference in cost for all cultivating time of $7.30 per acre, or $0.034 per box, in the favor of the mulch-crop system, but this difference is largely offset by the cost of irrigating on the latter orchards.

MULCH CROPS.

There are two kinds of mulch or shade crops used in the valley, namely, clover and alfalfa. (See fig. 9.) They are usually sown alone, although in some cases the orchard may be in both clover and alfalfa. Of the 24 orchards in mulch crop, there are 12 in clover, 8

in alfalfa, and 4 in both clover and alfalfa. About 12 pounds of alfalfa are sown per acre and 14 pounds of clover. Usually the orchards do not need reseeding unless plowed up. Thus, the cost of seed is a small item when distributed over several seasons and is almost negligible in arriving at the cost per box.

Of the 24 growers, 18, or about 75 per cent, make a practice of taking some hay from their orchards. One grower pastures his orchard, and four others mow the hay and leave it on the ground as a mulch. The number of cuttings made varies from one to three. The average yield of hay per acre on those orchards from which hay is cut is 1.5 tons for those in clover and 1.6 tons for those in alfalfa. These are actual yields for the years when hay is cut, but

FIG. 9.—A 13-year-old Newtown orchard under cover-crop system of management. Note the clover grown between the trees and the irrigation furrows.

when it is distributed over all years, including those when no hay is cut, the yield is 0.86 ton per acre for the clover and 1.54 tons for the alfalfa. Thus it is evident that the alfalfa orchards are not turned under nearly so often as those in clover.

The cost per ton of harvesting this hay is the same in both cases. In harvesting hay a man and team with mowing machine are usually used for cutting the hay between the rows and a scythe used for mowing out the tree rows. It is raked either by hand or by horse-rake and when cured is usually drawn in on a sled, as it is much easier to load a sled than a wagon in the orchard. The cost of harvesting is no doubt higher per ton than would be the case in an open field.

TABLE IX.—*Labor yields, and credits for mulch or shade crops for the growers who harvest hay.*

Item.	Clover.	Alfalfa.	Mixed.	All mulch crops.
Number of records	9	6	3	18
Labor per acre:				
Man-hours	8.50	14.92	12.71	11.34
Horse-hours	7.44	13.74	10.94	10.13
Cost of harvesting:				
Per acre	$3.03	$5.42	$4.50	$4.07
Per ton	$3.52	$3.52	$3.10	$3.42
Yield per acre (tons):				
Actual	1.51	1.59	1.47	1.53
Minimum	.60	.80	.67	.60
Maximum	3.00	3.00	3.00	3.00
Distributed [1]	.86	1.54	1.45	1.19
Total credit per acre	$9.24	$16.31	$15.75	$12.68
Net credit per acre	$6.21	$10.89	$11.25	$8.61

[1] Distributed over all years, including those when no hay is cut.

Credit from mulch crop.—The gross credit per acre for hay harvested amounts to $9.24 for the clover orchards and $16.31 for those in alfalfa, Taking out the labor cost of harvesting, there is a net credit of $6.21 for clover and $10.89 for alfalfa. Taking into consideration all mulch crops cut for hay there is a total credit of $12.68 for hay, or a net credit over harvesting labor of $8.61.

There is a growing tendency to pasture hogs on these mulch-crop orchards, and many growers are now raising pigs, so that pasturing may eventually become quite general. Five of the mulch-crop orchardists take no hay off, but cut it and leave it on the ground in the form of green manure, which no doubt pays as well in the long run as removing the hay. This practice should materially increase the yield of fruit.

When the 24 records under this system of management are all considered, whether hay is taken off or not, there is found to be an annual charge of $3.41 per acre for labor put on the mulch crop in cutting or harvesting it and an annual total credit of $9.59 per acre, or a net credit of $6.18 per acre.

Clean culture versus mulch or shade crops.—There seems no doubt that the practice of clean cultivation without the addition of humus or plant food by means of some kind of mulch crop soon will be wholly discontinued. There are several very apparent reasons brought out in the study of these 54 farms why the mulch-crop method of management is much the better. If figures are left wholly out of consideration the mere condition and appearance of the orchards would warrant this conclusion. (See fig. 10.) The bearing orchards under the clean-cultural system often show a decided discoloring and early maturity of foliage. This is most noticeable when the orchard tracts of the valley are viewed from one of

the distant hills. One can invariably pick out the orchards under the two kinds of soil management by the appearance of the foliage, that of the intensively clean cultivated orchards often having a light yellowish appearance. Lack of irrigation of course has much to do with this difference, but even irrigation without the addition of humus will not long give color and health to a bearing orchard. The older the orchard, the more noticeable is the difference in the physical condition of the trees under the two systems of management.

The average soil of the valley is of such a type that it becomes nonproductive after excessive cultivation. This is one reason why the use of a mulch crop shows results. The costs also show an advantage

FIG. 10.—A clean-cultivated orchard which has never been irrigated. The trees are Esopus and Newtown and are in need of humus or nitrogen.

in favor of the mulch crop. The maintenance labor is $43.63 per acre, or $0.2001 per box, for the 30 clean-culture orchards. The net labor cost in the case of the 24 mulch-crop orchards is $35.41 per acre, or $0.1554 per box. Thus there is a difference in maintenance labor of $8.22 per acre, or $0.0447 per box in favor of the mulch-crop system. Also yields are higher under the mulch-crop system, and the orchard is more healthy and has a better appearance generally. These advantages will undoubtedly become more and more apparent as the system becomes better established in these orchards and has more time to show results. In considering the farms studied it would seem best not to leave the crop down too long, but to turn it

under occasionally. The advantage of the mulch-crop system over the clean-cultural apparent here may or may not hold good in other sections. It depends entirely on whether or not the soil can be kept from being depleted and the trees in good health by natural soil fertility.

IRRIGATION.

Irrigation has become general in the valley only during the last 5 years and mostly within the last 3 years, and is rapidly extending. With the practice of irrigation has come an effort to restore nitrogen to the soil by the aid of clover and other legumes. Both irrigation and the practice of sowing legumes are confined largely to the old

FIG. 11.—An irrigation lateral in the Oak Grove district of Hood River Valley.

orchards, it not being thought necessary, in most cases, to irrigate a young orchard not yet in bearing.

The growers of the lower valley are served by three main irrigation ditches. Those on the east side of the river, including practically all the men whose records figure in this investigation, receive water from the East Fork irrigation ditch, while those on the west side receive water from the Hood River irrigation district canal and the Farmers' Irrigating Co. canal. The East Fork and the Hood River irrigation ditches are in bonded districts, while the Farmers' Irrigating Co. is not. The East Fork company, organized in 1895, was operated as a stock company of farmers until 1913, when

the district was bonded. In 1914 the rate per acre under the ditch was $1.24, while for 1915 it was $2.50 per acre. Previous to this the rate was from $5 to $8 per miner's inch, the farmer buying as much water as he desired. There is an area of over 13,000 acres under this ditch. (See fig. 11.)

The water is usually turned on from the 1st to the 15th of June. The orchards are ordinarily rilled out for irrigation. Some growers prefer to flood their orchards, but this is not a general or popular practice. As yet the irrigation system is far from being universally satisfactory. As in many other places, it takes time to adjust conditions when changing from a dry-land system of farming to one of irrigation. Prior to the time the ditch was bonded those not

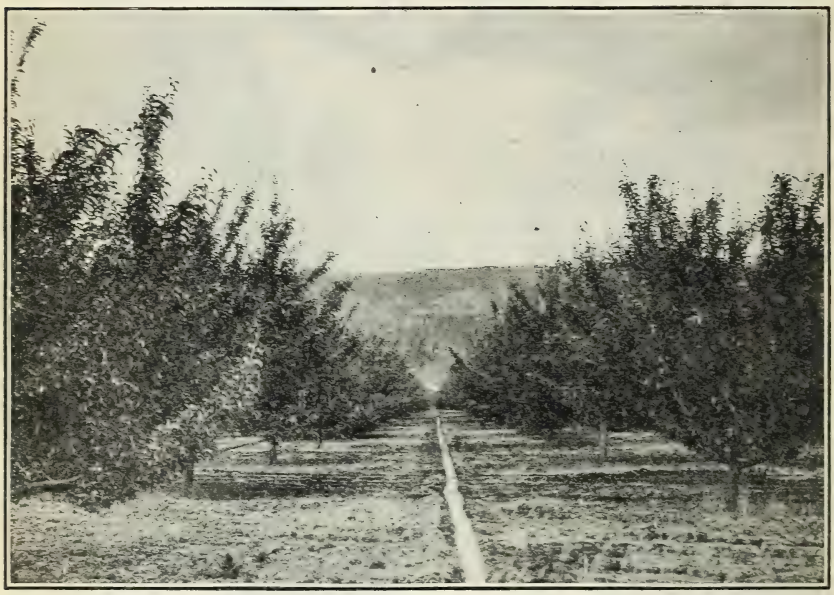

FIG. 12.—One method of irrigation followed in the lower valley. This is a temporary lateral and rills are made at right angles to it. This is not the common method.

holding stock received no water unless they used waste water, which was always uncertain.

Twenty-seven per cent of the clean-cultivated orchards and 100 per cent of those under mulch crops are irrigated.

Creasing, or rilling out, is a general practice in the clean-culture orchards. Usually about two irrigations are made on these orchards, the first coming about the latter part of June and the second about the 1st of August. Rilling is not generally practiced in the mulch-crop orchards, the soil being creased but once after sowing. Creasing is usually done with homemade drags, or "rillers." Four, five, or more furrows ordinarily are made at a time, at an average distance

of 30 inches apart. The bottoms of these rillers are rounded off so as to make smooth creases. The drags are usually drawn by two horses.

Mulch crops are often irrigated by flooding. The water is conducted from the main ditch through the orchards either in wooden flumes or in open ditches. In a few cases piping has been installed. The main laterals through the orchard are run along the higher ridges or along the more elevated side of the orchard tract. If flumes are used, the water is let out through holes placed at intervals in the side of the flume; if in open laterals, at the same intervals by means of openings made with a hoe. The water then seeks its own course over a strip usually only a few tree rows wide, following more or less the rills made at the time the mulch crop was sown. This practice keeps water on some part of the orchard for the greater part of the summer months. In many cases the grower finishes each irrigation of his orchard tract just about in time to begin irrigating again. (See fig. 12.)

TABLE X.—*Time and cost of irrigation of farms studied (Hood River Valley).*

Type of orchard.	Per cent of orchards irrigated.	Average number of irrigations.	Man-hours per acre.		Cost pro rata.[1]		
			Number.	Cost.	Labor.	Water.	Total.
Clean cultivated	26.67	2.38	11.86	$2.67	$0.71	$0.71	$1.42
Mulch crop	100.00	3.38	29.60	6.66	6.66	2.62	9.28
All orchards	59.26	3.13	25.16	5.66	3.35	1.56	4.91

[1] Cost pro-rated over irrigated and nonirrigated orchards.

The yield per acre of the 8 clean-culture orchards under irrigation is 257 packed boxes, as compared with 203 packed boxes for the 22 orchards not irrigated, with a total cost per box of $0.98 for the former and $1.045 for the latter. However, the orchards which were irrigated average about 4 acres less in area, which partly accounts for the greater yield.

Orchards set fruit well and grow well under natural conditions, but the fruit does not often attain its best size without irrigation.

The labor cost of irrigating is $2.67 per acre for those orchards in clean cultivation which practice it and $6.66 for those in mulch crop. Considering the 54 records, there is an average annual acre charge for labor in irrigation of $3.35, or $0.0151 per box.

THINNING.

Thinning is practiced by all growers in the valley. Some thinning is usually done each year and is practiced for several reasons, but chiefly to improve the size and quality of the fruit remaining on the

tree. Men differ widely in their ideas on thinning. There is no doubt that systematic thinning greatly increases the size and quality of the remaining fruit, and the quantity of marketable fruit is invariably increased. The belief prevails and results apparently show that annual thinning tends to produce more even and more certain annual crops. (See fig. 13.)

Thinning involves considerable labor. Women are sometimes employed for this operation, the work being performed usually by the operator and the members of his family, but sometimes by hired laborers. Only white labor is intrusted with this work. Most often only clusters are thinned, leaving one or two apples in a cluster.

FIG. 13.—Thinning Newtown apples. The cost of thinning in Hood Valley is as great as the cost of pruning.

This is particularly true of the Yellow Newtown. The operation is performed largely from ladders with thinning shears.

Most of the thinning is done early in the summer, since thus the remaining apples make a better growth and at the same time the tree itself remains in better physical condition than when the thinning is done later, thereby insuring a more regular and uniform crop each year.

The area of the orchard has some influence on the time per acre devoted to thinning. In the case of orchards under 5 acres in area the difference in time is very marked (see Table XI.) Small acreages are usually more intensively managed as regards thinning, as well as in many other respects.

TABLE XI.—*Relation of area of orchard on farms studied to time devoted to thinning.*

Size of orchard.	Number of orchards.	Man hours per acre.	Cost.		
			Per acre.	Per tree.	Per box.
Under 6 acres	4	44.75	$10.07	$0.13	$0.0358
6 to 10 acres	25	24.57	5.53	.08	.0243
11 to 15 acres	11	22.25	5.01	.07	.0221
Over 15 acres	14	20.87	4.70	.07	.0244
All orchards	54	24.63	5.54	.08	.0250

There is abundant evidence that it pays to thin the fruit and do it well. Not only is the yield of marketable fruit increased, but its quality is greatly improved, thus giving a high percentage of extra fancy fruit which brings correspondingly high returns. The average annual time consumed in thinning on the 54 orchards is 24.63 hours per acre, at a cost of $5.54 per acre, $0.08 per tree, and $0.025 per box. It should be borne in mind that this is an average cost. Where a tree is well loaded with fruit the cost of thinning may reach $0.25 or more per tree, but the cost per box will tend to be lowered.

PROPPING.

Propping the trees to prevent the limbs from breaking under the weight of fruit is a practice followed by all growers. (See fig. 14.) The labor for propping on the farms studied amounts to practically the same as that for pruning. Several methods of propping are practiced; first, that of propping the trees with notched or cleated boards; and, second, that of "tying up" the limbs of the trees, eliminating the use of board props. In tying, some growers use the "maypole prop," from the top of which wires or strings are strung and tied to the limbs requiring support. In many cases, however, the tying is done from limb to limb.

The material used in making the board props is often 1 by 2 inches or 1 by 3 inches, varying in length from 8 to 14 feet. Double-ply jute twine, costing about 10 cents a pound, is used in tying. Wire, also used for this purpose, is much more expensive, but lasts a correspondingly longer time. The labor connected with tying up the limbs is considerable; indeed, it is often a very expensive operation.

Board props are usually set during July. The orchardist generally hauls them out with a wagon and two horses, setting them as he hauls. Sometimes they are distributed to be set later. Where the limbs are tied to the props additional labor is entailed. Props have to be tended and reset from time to time during the summer and

taken down and hauled in in the fall. On account of the variation in the methods of propping and the small number of orchardists who followed any one method, no segregation in time is made, the average propping time being calculated without regard to the practice followed.

The average amount of labor for propping, all records considered, is 14.23 man-hours and 13.56 horse-hours per acre, at an annual cost of $5.65 per acre, $0.08 per tree, and $0.0255 per box.

The average cost per acre on these farms is almost exactly the same for each of the three operations of pruning, thinning, and propping. (See Table XII.)

FIG. 14.—Trees propped to prevent breaking. This orchard is also heavily thinned every year. The varieties are Newtown and Esopus, in full bearing.

TABLE XII.—*Comparison of pruning, thinning, and propping costs (54 farms).*

Operation.	Number of orchards.	Cost.		
		Per acre.	Per tree.	Per box.
Pruning	54	$5.48	$0.08	$0.0247
Thinning	54	5.54	.08	.0250
Propping	54	5.65	.08	.0255

SPRAYING.

Spraying the orchards for diseases and insect pests is a universal practice in the valley, representing considerable labor and cash out-

lay for the average Hood River grower. On the 54 farms the average spraying-labor cost is $8.83 per acre, or $0.0398 per box. The cost of materials for spraying is $8.69 per acre, or $0.0391 per box, a total cost for labor and material of $0.0789 per box. The use of the spray rig is a separate expense included under equipment charges. Forty-three growers own their own power-spray outfits, while 11 hire their spraying done. A number of steam spray outfits are still in use in the valley, but these are being replaced by gasoline power sprayers. The average size spray tank holds about 150 gallons, the size varying from 100 to 250 gallons. The pressure maintained in spraying varies from 150 to 225 pounds.

In spraying two or three men are commonly employed. When three men are used, which is the practice of 57 per cent of the growers, one man drives the team and tends the engine, while the other two handle the lines of hose. In nearly all cases two lines of hose about 50 feet long are used. A spray rod is attached to each hose. Where two men are used, as on practically 40 per cent of the farms, both hold spray rods.

The average length of spray rod is 10 feet, although a few 12-foot rods are used in the older orchards. The rods are usually bamboo over aluminum tubing. Spray towers are not used except in very few instances, the practice differing in this respect from that of many growers in the East. The trees are of a low habit of growth, so that ordinarily it is not necessary to use a tower in order to spray the top of the tree thoroughly.

The average crew of two men and a team, or three men and team, sprays about 5½ acres a day and applies from 1,100 to 1,500 gallons of material in this time. There is no appreciable difference in time between a 2–2 crew and a 3–2 crew, the extra man employed being the driver, two leads of hose being used in each instance. Two rows of trees are sprayed at a time, one lead of hose being used for each row.

The principal diseases which it is necessary to control in Hood River Valley are apple scab, apple powdery mildew, and anthracnose. The principal insect pests are San Jose scale, leaf roller, aphis, blister mite, and coddling moth.

Where a spray rig is hired, the usual rate paid is $1 per hour for man, rig, and team. Only the regular rate is here figured for the labor, leaving 47½ cents per hour for the use of the rig itself. This charge of 47½ cents is included in the fixed charges with depreciation and upkeep, in order to make the cost items comparable with those on farms having their own spray outfits.

TABLE XIII.—*Comparative efficiency of hired and of owned spray rigs on farms studied.*

Ownership of rig.	Number records.	Average number of sprays.	Total man-hours per acre.	Total horse-hours per acre.	Acres in 10 hours.	Gallons in 10 hours.	Total gallons per acre for all sprays.	Total gallons per tree for all sprays.	Cost per acre.			Cost per box.
									Labor.	Material.	Total.	
Own	43	5.7	26.39	20.99	5.38	1,172.14	1,241.81	17.31	9.09	8.71	17.80	0.0789
Hire	11	5.1	23.00	17.59	5.91	1,395.11	1,203.89	16.81	7.81	8.69	16.50	.0791
Own and hire	54	5.6	25.70	20.30	5.47	1,205.42	1,234.09	17.21	8.83	8.71	17.54	.0790

The comparative efficiency of the owned and hired rigs is shown in Table XIII. The average number of sprays is 5.7 for the owned and 5.1 for the hired rigs. As would be expected, there are fewer man and horse hours per acre in the latter case. It is seen that those who own rigs spray an average of 5.38 acres in 10 hours, applying 1,172 gallons of material, while hired rigs spray 5.91 acres, applying 1,395 gallons in 10 hours. Thus, although the labor cost per acre is less in the case of the hired rigs, the total material cost is nearly the same. The cost of labor and material for the owned rigs is $17.80 per acre, while for the hired it is $16.50 per acre. It would seem therefore that so far as the actual labor and material cost of spraying is concerned, it makes little difference whether the rig is owned or hired.

Because of the effect of climatic conditions upon spraying, no well-defined spraying schedule is followed in the valley. Most growers have their own ideas about spraying. Some troubles, particularly apple scab, are very hard to control, and spraying is as yet in somewhat of an experimental stage here.

This region differs from most others in that a great many different kinds of sprays are made of varying strength. The first spray applied in the spring is usually a lime-sulphur dormant spray, which is applied ordinarily in March. This, often called the "clean up" spray, is made primarily to control the San Jose scale. The strength of this spray is usually 1–10, that is, 1 gallon of commercial lime-sulphur to 10 gallons of solution. Usually a single nozzle and a coarse spray are used, with a pressure of about 175 pounds. Practically 90 per cent of the growers make a practice of using this spray, and make but one application of it during a season. Man-hours per acre for this spray average 4.74 and the horse-hours 3.72. The average acreage for all crews is 5.38 acres per day. The labor cost per acre is $1.62, material cost $2.45, making a total of $4.07 per acre. If this spraying cost is distributed over all the orchards

the cost is found to be $3.55 for material and labor, or 20 per cent of the total spraying costs on all the orchards considered.

A later dormant spray is now being advocated for killing the leaf roller and aphis eggs. It is made with a soluble oil or miscible oil, diluted and mixed with water at the rate of about 3 gallons of oil to each 50 gallons of spray mixture. In applying this, high pressure is used, and the spray is driven against the branches with great force. The nozzles are held close, so as to cover thoroughly the terminal buds, fruit spurs, and smaller limbs. Large-chamber type mist nozzles are used for this purpose. This spray is not generally practiced as yet, but it is increasing in favor.

The second regular spray is generally applied about the time the fruit buds are showing pink and is known as the "pink spray." In the lower valley it is made around April 20. This is applied primarily as a preventive against apple scab. A 33° Baumé (25 per cent sulphur in solution) lime and sulphur solution, mixed at the rate of 1–25, or 2 gallons of the solution to each 50 gallons of spray, is the strength generally used. This spray, used by about 50 per cent of the growers, is applied very thoroughly. The aim is to cover the entire surface of the tree, paying particular attention to the leaf buds and expanding fruit buds. The average time in applying the pink spray, together with other lime-sulphur sprays which may be later applied without lead, is 4.13 man-hours and 3.39 horse-hours per acre, or an average of 5.9 acres per day. About 1,300 gallons of material is used in 10 hours. The labor cost of $1.44 and a material cost of $0.97 make a total of $2.41 per application. The cost of all lime-sulphur diluted sprays applied for scab (in combination with no other material) is $1.39 per acre, or about 8 per cent of the total cost for spraying for all orchards.

The third regular spray, and perhaps the most important of all, is the calyx, or first arsenate of lead spray, coming about May 10, when about 90 per cent of the petals have fallen. This spray is applied so as to place the poison well into the calyx cup, for the control of the codling-moth larva. A fungicide is ordinarily used at this time, in order to cover the foliage and forming fruit as a preventive for apple scab. The "calyx spray" is made by all orchardists of the valley, although there is some variation in the kind and quantities of spray materials used.

A common mixture used by about two-thirds of the growers is made of 1 gallon of lime-sulphur and 2 pounds of paste lead arsenate to 50 gallons of spray mixture. A few use only lead arsenate and water at the rate of about 2 pounds of lead arsenate to 50 gallons of water. For the most part those who use no lime-sulphur use a

Bordeaux 4–4–50 solution—that is, 4 pounds of lime, 4 pounds of blue vitriol, and 50 gallons of water. The lead arsenate is used the same strength as above. In all cases growers use arsenate of lead in this spray for the control of the codling-moth larva, although some omit the other ingredients. Where either Bordeaux or lime-sulphur is used it is for the control of apple scab. Some growers now make a practice of using about 3 pounds of atomic sulphur to 50 gallons of spray mixture for apple powdery mildew, and apply it in combination with the calyx spray.

Whatever mixture is used, the number of acres sprayed per day is between 5 and 6. Cost for labor is $1.47 per acre for diluted lime-sulphur and lead-arsenate spray, $1.50 for Bordeaux and lead arsenate, and $1.54 for lead-arsenate spray alone. The material cost for these sprays is $1.48, $2.41, and $0.75, respectively, or a total labor and material cost of $2.95, $3.91, and $2.29. (See Table XIV.) The lead arsenate and water spray is thus the cheapest, followed by the lime-sulphur and lead arsenate, and, lastly, the Bordeaux and lead arsenate, which is much the most expensive. In this calyx spray the most popular and, judging by the number using it, evidently the most effective combination is the lime-sulphur and lead-arsenate spray. If mildew is troublesome, atomic sulphur may be added.

The next lead-arsenate spray follows the calyx application in about 10 days. It is made by only a part of the growers. If the weather is favorable to apple scab, lime-sulphur, diluted 1 to 40 or 1 to 50, or atomic sulphur, 5 pounds to 50 gallons, is often added to this lead-arsenate spray. Some growers do not put lead arsenate in this spray, but use only the lime-sulphur or atomic sulphur.

The "thirty-day" spray is usually the second and a very essential spray for the control of codling moth. This occurs about 30 days after the calyx spray, hence its name. Lead arsenate at the rate of 2 pounds to 50 gallons is used. Atomic sulphur may be added at the rate of 5 or 6 pounds to 50 gallons for scab and mildew control.

Other sprays for scab control are sometimes applied if the weather continues wet, and ordinarily the third and last lead-arsenate spray for the codling moth is applied about the 1st of August. However, there may be an intervening codling-moth spray between the thirty-day spray and the final spray for the moth. In this spray lead arsenate is applied at the usual rate of 2 pounds to 50 gallons of water. Bordeaux 4–4–50 may be combined with this as a further protection against scab. In many of these sprays, particularly the early ones, a nicotine solution is often added for the control of the aphis, at the rate of about 1½ pints to 200 gallons of spray mixture.

TABLE XIV.—*Spraying practices (54 farms).*

Item.	Lime-sulphur, dormant.	Lime-sulphur diluted, not dormant.	Lime-sulphur diluted and lead arsenate.	Lead arsenate.	Bordeaux and lead arsenate.	Fall [1] Bordeaux.	Other sprays.	Total of all sprays.
Number of growers using	47	27	36	42	9	42	1	54
Average number of sprays	1	1.15	1.81	2.26	1.56	1.24	1	5.65
Number using 3–2 crew	28	13	19	24	7	22	1	31
Number using 2–2 crew	17	12	16	16	1	18	0	21
Number using other crews	2	2	1	2	1	2	0	2
Averages per spray:								
Man-hours	4.74	4.13	4.29	4.49	4.31	5.06	8.57	4.55
Horse-hours	3.72	3.39	3.38	3.51	3.54	3.99	5.71	3.59
Labor cost	$1.62	$1.44	$1.47	$1.54	$1.50	$1.74	$2.78	$1.56
Material cost	2.45	.97	1.48	.75	2.41	2.28	4.41	1.54
Total cost	4.07	2.41	2.95	2.29	3.91	4.02	7.19	3.10
Total cost of spraying per orchard using sprays	4.07	2.77	5.33	5.19	6.08	4.98	7.19	17.54
Average total cost of spraying for all orchards studied	3.55	1.39	3.55	4.03	1.02	3.87	.13	17.54
Percentage of total spraying costs	20.24	7.92	20.24	22.98	5.82	22.06	.74	100.00

[1] Of these 42 growers making a fall Bordeaux spray for anthracnose, 10 made an additional spray during the summer with Bordeaux alone for apple scab control, using a strength of 4–4–50 as compared to a 6–6–50 strength for the fall spray.

As a general rule a final spray is applied in the fall for anthracnose. Nearly 78 per cent of the growers use this spray. It is a dormant spray, applied after harvesting the fruit, and is made with a 6–6–50 mixture of Bordeaux. It often takes a little longer to apply than the other dormant sprays or the lead arsenate spray, because of the time required for mixing the ingredients.

In Table XIV spraying practices are summarized. On account of the great number of different practices followed in spraying, no attempt has been made to arrange this table according to the time of application. The average number of sprays of all kinds used for all orchards is 5.65, and the total cost for material and labor for these sprays is $17.54 per acre, or practically $0.08 per box.

MISCELLANEOUS.

There are many items of orchard labor which may be classified as miscellaneous. Summer pruning is included in miscellaneous labor, as are all such items as doctoring trees, painting wounds, care of lateral ditches for the orchard not included in irrigating time, and any other odd items which may appear. For these miscellaneous items there was found to be a labor cost of $2.03 per acre for the clean-cultural orchards, $1.17 per acre for those under the mulch-crop system, or $1.65 per acre for all orchards. The cost per box was $0.0074.

TOTAL MAINTENANCE COST.

Considering all items pertaining to the maintenance of the orchard in the 30 clean-cultural orchards there is found to be a total of 133.75 man-hours and 90.28 horse-hours per acre, at a net labor cost for maintenance of $43.63 per acre, or $0.20 per box. In the case of the 24 mulch-crop orchards there are 152.75 man-hours and 70.82 horse-hours for annual maintenance, with a cost of $45 per acre, or $0.197 per box. When both kinds of orchards are considered, there are 142.19 man-hours and 81.63 horse-hours, with a total maintenance labor cost per acre of $39.97, or $0.18 per box. This is 47 per cent of all labor cost, and 17.6 per cent of the total cost of production.

HANDLING THE CROP.

The labor cost of handling the crop is the largest of all labor costs, and since it is necessary to handle the fruit in a comparatively short time the cash expense for harvest labor represents the largest cash expense of the season. The handling cost includes picking, hauling shooks to the ranch, hauling out empty boxes from the packing shed to the orchard, and hauling in full loose boxes of fruit to the packing house. It also includes labor in the packing house, sorting, packing, nailing, and stamping, waiting on the packers, foreman, trucker, or any other extra packing-house labor. The last labor item of handling is hauling the packed boxes to the station. This handling or harvesting cost makes up 59 per cent of the total labor cost, or 22 per cent of the total annual cost of production. The handling cost per box was found to be very uniform and varied but little except as affected by yields and acre costs.

PICKING.

Harvesting the fruit from the trees is done by hand, either from the ground or from ladders. Ten-foot stepladders, costing from 25 to 50 cents per foot, are most common in use. Picking pails and bags of various description are used. These picking bags or buckets hold about one-half bushel and usually empty from the bottom. Two usually fill a picking box. The boxes are not filled so full as to prevent one being placed on top of another in hauling them in.

Picking ordinarily begins late in August with the Gravenstein and ends with the Yellow Newtown and Ben Davis late in October. As over 80 per cent of the output of the valley is Yellow Newtown and Esopus, most of the harvesting comes during the month of October. The labor is usually hired by the day. In a few cases men hire pickers by piecework; that is, the picker is paid so much

per box. Day labor, however, is generally more satisfactory, as the apples are more carefully handled than when picked by the box.

Several factors influence the time required in picking, such as the variety, the age and size of the tree, and the condition of the fruit. The average time for all growers, with an average yield of 222 packed boxes, is 56 hours per acre, at a cost of $12.63, a cost per loose box of $0.0379 and per packed box of $0.0569, or nearly 6 cents per box.

TABLE XV.—*Influence of size of orchard on picking time (54 farms, Hood River Valley).*

Size of orchard.	Number orchards.	Boxes per acre.	Loose boxes in 10 hours per man.	Cost per acre.	Cost per packed box.	Cost per loose box.
Under 6 acres	4	280.9	59.8	$15.85	$0.0564	$0.0376
6 to 10 acres	25	227.7	59.5	12.91	.0567	.0378
11 to 20 acres	19	211	59.1	12.05	.0571	.0381
Over 20 acres	6	196.5	59.4	11.17	.0568	.0379
All records	54	222	59.4	12.63	.0569	.0379

The size of orchard and the yield per acre are two factors which would be expected to influence time required in picking. However, in the case of the farms studied this is not borne out by results, which show a remarkable uniformity in cost per box regardless of size of orchard or of yield. Table XV shows the cost of picking according to size of orchard, and Table XVI shows time and cost according to yield. It should be stated here, however, that the yield per acre would undoubtedly have affected the picking cost if the trees in general had been large, entailing much shifting of the ladders. This was noted in individual cases too scattering to materially affect the averages.

TABLE XVI.—*Influence of yield on picking time and costs (54 farms.)*

Yield (packed boxes).	Number of orchards.	Boxes per acre.	Boxes in 10 hours per man.	Cost per acre.	Cost per packed box.
150 boxes and under	11	115.0	58.1	$6.68	$0.0581
151 to 200 boxes	10	177.6	68.0	8.82	.0497
201 to 250 boxes	17	219.6	63.6	11.66	.0531
251 to 300 boxes	7	270.0	53.7	16.97	.0629
301 to 400 boxes	6	335.2	57.3	19.78	.0590
Over 400	3	440.8	52.7	28.24	.0641
All records	54	222.0	59.4	12.63	.0569

These tables show averages for hired pickers working by the day. They would show different results if piecework were under consideration. There is no doubt that the average picker can pick more boxes per day in heavily loaded orchards than in those with a light yield. The fact that they do not when hired by the day may be

attributed largely to the fact that day labor considers a certain number of boxes as a fair day's work. They will pick a reasonable number in any case, working faster or slower according to the yield, but actually picking few more per day in one case than in the other. This, of course, does not apply to men who do their own picking or to other help personally interested in an orchard.

HAULING.

There are four hauling operations, namely, hauling the loose box shooks from the station to the ranch to be made up, hauling the empty boxes to the orchard, hauling the full picking boxes to the packing house, and hauling the packed boxes to the loading station. In hauling shooks, in the case of the farms studied, one man and team will haul an average load of 433 box shooks 2.01 miles at a cost of $0.004 per box shook, or $0.002 per box shook per mile. In many cases the box shooks are delivered at the farm, the price of delivery usually being from one-quarter to one-half cent per box. Taking all cases the cost per acre for getting the box shooks to the farm, including the contract labor, is $0.83 per acre, or $0.0037 per box. The box shooks are usually hauled during the late summer, early enough to give the grower time to make up his boxes. Hauling the loose boxes to the orchard from the shed, or wherever they are made up, is comparatively inexpensive, as they may be stacked on a sled or wagon and many of them hauled out at once. The most common practice is to combine hauling out the empty boxes with hauling in the full boxes. For those who make a separate operation of hauling out the empty boxes the cost per box averages about one-half cent. In hauling in the full boxes, where no hauling-out time is considered, it is found that a man and a team, with a wagon or truck, will haul 42 loose boxes per load, at a cost of $0.015 per packed box. When both hauling out and in are considered the cost is $3.59 per acre, or $0.016 per packed box. Either one or two men may work at hauling the full loose boxes to the shed. Where there are enough pickers to keep the haulers busy, two men can do this work to better advantage than one. This hauling is done almost entirely on the low truck wagon. (See Table XVII.)

TABLE XVII.—*Average time required for hauling on farms studied when man and team are used.*

Item.	Man-hours per acre.	Horse-hours per acre.	Cost per acre.	Size of load.	Cost per packed box.	Number of miles.	Cost per box per mile.
				Boxes.			
Haul shooks	1.80	3.35	$0.91	433	$0.0041	2.01	$0.002
Haul in full boxes	7.05	12.82	3.51	42	.0152	.....	.....
Haul to station	11.73	23.46	6.16	87	.0285	4.00	.007

The most expensive of all hauling operations is delivering the apples at the shipping station. A man and team haul on the average 87 boxes per load 4 miles, at a cost of $0.0285 per box for the average distance hauled, or $0.007 per box per mile. There is considerable contract hauling, while many boxes are shipped to the association at Hood River via the Mount Hood Railroad at a freight cost in the lower valley from 2½ cents to 3½ cents per box. Considering all records, the total cost of delivering these apples f. o. b. at Hood River station is materially increased by this freight charge, making a total cost of $8.28 per acre or $0.0373 per box. The total cost of all hauling for the 54 farms, including the shooks, loose boxes in the orchard, and hauling to the station, including contract hauling, is $12.70 per acre, or $0.0572 per packed box.

PACKING-HOUSE LABOR.

Labor in the packing house includes sorting, packing, nailing, stamping, waiting on the packers, foreman, and any other labor employed about the packing shed. The cost of making the box is not included here, but under the cost of made-up box. This labor, when all records are considered, amounts to $0.1073 per box, or about 50 per cent of all handling labor costs, and 28 per cent of the total labor cost.

TABLE XVIII.—*Packing house averages and practices on farms studied.*

Operation.	Number practicing.	Per cent practicing.	Man-hours per acre.	Packed boxes in 10 hours per man.	Cost per acre.	Cost per packed box.	Pro rata cost per box.
Packing	53	98.15	29.03	77.5	$10.24	$0.0457	$0.0453
Sorting	32	59.26	43.62	53.3	9.81	.0463	.0262
Machine sizer	21	38.89	34.31	82	7.72	.0320	.0135
Nailing	14	25.93	10.20	232	2.30	.0108	.0027
Nail and wait	40	74.07	14.13	200	3.18	.0141	.0106
Foreman	16	29.63	13.28	213.4	2.99	.0121	.0040
Waiting	6	11.11	11.31	260	2.54	.0096	.0013
Other packing labor	6	11.11	33.03	95	7.41	.0357	.0037
Total cost per box							.1073

Table XVIII shows the packing-house practices, indicating the number who practice the different operations, together with the average time and costs per acre and per box. The pro rata column is the cost per box distributed over all the records, so that the total column represents the actual packing-house cost for the 54 records.

Sorting.—All apples are sorted and packed in the packing shed or tent. There are two methods of sorting. The apples may be sorted either by hand or on the sorting tables of a sizing maching. Previous to the introduction of the sizing machine many apples were

sorted and packed by women. Usually on the larger ranches men are now employed in the packing house.

The crew in the packing house will vary with the size and condition of the crop. It is usually necessary to have more sorters than packers. Often four sorters are necessary to keep three packers busy.

Many growers use a mechanical sizer and claim that much time and expense is saved. These machines cost from $125 to $250 each. In the type most generally used the apples are dumped upon padded tables at the end of the sizer. From these they are placed on an endless carrier, the extra fancy apples on one side and the fancy on the other side of a partition. Choice, or C grade apples, as well as cookers and culls, are not put through the machines at the same time, although they may be sized later. The sizing device permits the apples to roll down into padded bins or receptacles placed along the side of the carrier.

Most of the growers, however, sort by hand. The sorters work at tables and sort from the loose boxes into three grades, but do not size the fruit. Sorters are paid usually by the hour. When working at a sizer they will sort 82 packed boxes, or about 120 loose boxes, a day. By hand they will sort 53 packed or about 75 loose boxes. The labor cost of sorting for those who use a sizer is $0.032 per packed box, or $0.021 per loose box, while for those who sort by hand it costs $0.046 per packed box, or $0.031 per loose box. Sorting time depends very largely on the relative freedom of the fruit from insect injuries and fungus disease.

Packing.—Packers work by the box, and men and women are paid at the same rate. Many growers prefer women to men for packing fruit. They apparently become expert packers much more quickly, and do neater work than men, although usually averaging fewer boxes during the season. Packing labor in Hood River Valley generally receives 4 to 5 cents per packed box. The 4-cent rate is paid where apples are both sized and graded for the packer; that is, where a sizing machine is used. The 5-cent rate is used where the apples are graded for the packer, but not sized; that is, when the sorting is done by hand. Packing is done at benches along the side of the sizing machine. When hand sorting is done the packers usually work at tables or benches. The diagonal method of packing is commonly used. All three grades of apples are wrapped. Sometimes cookers are also wrapped. Cardboards are placed inside both on the top and the bottom of the box. Packers earn higher wages than day help. The average packer packs 77.5 boxes per 10-hour day in the case of the 54 orchards considered.

Nailing and stamping.—All boxes are nailed, and stamped with the name of the grower, the grade, the number of apples in box, the variety, the packer's number, and the cubical contents of the box, which is 2,173 cubic inches. The nailing bench or rack is arranged with a device for holding down the box cover over the bulge so that it meets the ends of the box and can be easily nailed. The nailer is usually an expert and nails very rapidly, but for an amateur it is slow work. In all cases the nailer also stamps the boxes; in 74 per cent of all cases he also helps to wait either on the packers or on the sorters. The average nailer will nail and stamp 232 boxes per day, and the average cost per box is about 1 cent. Some men nail and stamp by piecework; the usual price paid is 1 cent per box. In the case of nailing and waiting the cost is higher, being $0.014 per box. One or more waiters, according to the number and size of the crew used in packing, carry apples to the sorters as needed, and carry graded apples from the sorters to the packers. In many cases sorters and packers wait on themselves. Especially is this true where the orchard is small and there is not a great amount of fruit to pack. In large packing crews a trucker is often employed who trucks the nailed-up boxes from the nailers and stacks them up ready to be hauled.

Where mechanical sizers are used one extra man is often employed to look after the machine and usually acts as foreman. Sixteen of the growers, or not quite one-third, had foremen who had no other duties but supervision, and whose labor is charged entirely to the boxes put out by the packers. There was but one grower of the 54 who sorted his apples as he packed them; that is to say, the packer sorted his own apples. In Colorado and many other Northwest sections a great many packers sort their own apples.

That sorters are employed more generally in Hood River than in most other sections, and that the sorting cost is about as great as the packing cost, is due largely to the fact that Hood River apples are carefully watched for spots caused by the apple scab, a fungus prevalent in that region.

The cost of all labor employed about the packing house for Hood River Valley is $0.1073 per packed box. There is a chance to lower labor costs in the packing house materially in the case of many growers. If the crew is not large the foreman may very well be a packer, sorter, nailer, or the like, but all crews, whatever their size, do need a packing foreman to see that the apples are properly sorted and packed. Some growers have already lowered their harvesting cost per box materially by increasing efficiency in the handling of harvesting crews, both inside and outside of the packing house; but in general there is room for considerable improvement in this regard.

Culls.—Under "culls" are included all apples which do not meet the standards required for box apples. The best of them are sold for "cookers" in loose boxes or crates. The poorer grades are used for making cider or they may be fed to the hogs. A cooperative cider factory is operated in Hood River, the stockholders buying stock amounting to $10 per acre for their bearing orchard land. The grower then gets the privilege of selling all his cider apples to the factory. Nonmembers receive the same price per ton as do members, but are able to dispose of their fruit only when the demand exceeds the supply offered by the members. In 1914 the price per ton for cider apples was $6, but in prior years the price of cider apples had usually been $8. Some cider apples are sold to Portland firms. Windfalls and other inferior apples are taken to the cider mill. Part of these are picked up on the ground and sacked in the orchard, and part of them come from the packing shed, where they have been handled by the sorters. Many orchardists do not pick up the fruit which drops from the trees, but leave it on the ground and allow the hogs to have it.

The term "cookers" is usually applied to those apples which have some minor defect or blemish. They are "jumble" packed and usually shipped to Portland. They average about 50 cents per box f. o. b. Hood River. Some growers do not ship "cookers." In this study "cookers" were taken into account only when marketed.

The average annual credit derived from culls, including "cookers," on the 54 farms studied is $5.13 per acre, or a net credit of $4.06 above the labor of picking and hauling, which amounted to $1.07 per acre. This, it should be remembered, is only labor in excess of that already included under harvesting and packing-house labor. Where the apples are picked up in the orchard one man will sack or pick up about 50 sacks per day. A man and team will haul about 2 tons of cider apples per load and 2 loads per day from the lower valley to Hood River, a distance usually of from 4 to 6 miles. The filled sacks weigh about 70 pounds each. In marketing the cull fruit which comes from the packing shed all the extra handling necessary is the hauling. Hence there is greater profit in handling these than in handling windfalls.

TOTAL HANDLING COSTS.

The total of all harvesting-labor cost for the 54 farms, allowing no credit for culls, is $49.14 per acre, or $0.221 per box. Deducting the net value of the culls there is a net labor cost of $45.08 per acre, or $0.203 per box. This is 53.01 per cent of all labor costs and 19.86 per cent of the total cost of production. If the labor cost of handling is added to the material and fixed cost connected with handling, which includes made-up boxes, paper, nails, and the annual packing-

house costs, there is a total cost for handling of $79.92 per acre, or $0.36 per box. This is 35.21 per cent of the total annual cost of production.

TOTAL LABOR COSTS.

Table XIX summarizes the labor costs per acre and per box for both the clean-culture and the mulch-crop system of management.

TABLE XIX.—*Summary of all labor costs.*

	Clean cultural; 30 records; yield 218 boxes.				Mulch crop; 24 records; yield 228 boxes.				All records; 54 records; yield 222 boxes.			
	Cost per acre.	Cost per box.	Per cent of total labor cost.	Per cent of total cost of production.	Cost per acre.	Cost per box.	Per cent of total labor cost.	Per cent of total cost of production.	Cost per acre.	Cost per box.	Per cent of total labor cost.	Per cent of total cost of production.
Manuring	$1.60	$0.0073	1.82	0.72	$1.01	$0.0044	1.24	0.44	$1.34	$0.0060	1.58	0.59
Pruning	5.28	.0242	6.02	2.37	5.74	.0252	7.03	2.47	5.48	.0247	6.44	2.41
Disposal of brush	2.45	.0112	2.79	1.10	2.25	.0099	2.75	.97	2.36	.0106	2.77	1.04
Plowing	1.10	.0050	1.25	.49	.70	.0031	.86	.30	.92	.0041	1.08	.40
Cultivating	10.64	.0488	12.12	4.78	3.74	.0164	4.58	1.61	7.57	.0341	8.90	3.34
Irrigating	.71	.0033	.81	.32	6.66	.0292	8.15	2.87	3.35	.0151	3.94	1.48
Thinning	5.60	.0257	6.38	2.51	5.47	.0240	6.70	2.36	5.54	.0250	6.51	2.44
Propping	5.71	.0262	6.51	2.56	5.58	.0245	6.83	2.40	5.65	.0255	6.64	2.49
Miscellaneous	2.03	.0093	2.31	.91	1.17	.0051	1.43	.50	1.65	.0074	1.94	.73
Lime-sulphur spray	1.30	.0060	1.48	.58	1.52	.0067	1.86	.65	1.40	.0063	1.65	.62
Other sprays	7.21	.0331	8.21	3.24	7.70	.0338	9.43	3.31	7.43	.0335	8.74	3.27
Sowing mulch crop	------	------	------	------	.05	.0002	.06	.02	.02	.0001	.02	.01
Harvesting mulch crop	------	------	------	------	3.41	.0150	4.17	1.47	1.52	.0068	1.79	.67
Total labor cost previous to harvesting	43.63	.2001	49.70	19.58	45.00	.1975	55.09	19.37	44.23	.1992	52.00	19.49
Hay credit	------	------	------	------	9.59	.0421	11.74	4.13	4.26	.0191	5.01	1.88
Total net labor cost previous to harvesting	43.63	.2001	49.70	19.58	35.41	.1554	43.35	15.24	39.97	.1801	46.99	17.61
Haul shooks	.84	.0039	.96	.38	.82	.0036	1.00	.35	.83	.0037	.98	.37
Haul loose boxes to and from orchard	3.55	.0163	4.05	1.59	3.64	.0160	4.46	1.57	3.59	.0162	4.22	1.58
Picking	11.97	.0594	13.64	5.37	13.46	.0590	16.48	5.79	12.63	.0569	14.85	5.56
All packing house labor	23.59	.1082	26.87	10.58	24.09	.1057	29.49	10.37	23.81	.1073	27.99	10.49
Haul to station	8.40	.0385	9.57	3.77	8.14	.0357	9.97	3.50	8.28	.0373	9.74	3.65
Pick up and haul culls	1.11	.0051	1.26	.50	1.03	.0045	1.26	.44	1.07	.0048	1.26	.47
Total labor cost for harvesting	49.46	.2269	56.35	22.19	51.18	.2244	62.66	22.02	50.21	.2262	59.04	22.12
Credit for culls	5.31	.0244	6.05	2.38	4.91	.0215	6.01	2.11	5.13	.0231	6.03	2.26
Total net labor cost for harvesting	44.15	.2025	50.30	19.81	46.27	.2029	56.65	19.91	45.08	.2031	53.01	19.86
Total net cost for all labor	87.78	.4026	100.00	39.39	81.68	.3583	100.00	35.15	85.05	.3832	100.00	37.47

It will be seen from this table that soil management is the only factor of either system that has any great influence on the labor-cost items. The only credits are for hay and culls, the hay credit lowering the net cost of maintenance somewhat, this cost being $43.63 per acre in the clean-culture and $35.41 per acre in the mulch-crop orchards.

The cull credit is about the same in both cases. There is then a total net labor cost for the clean-culture orchards of $87.78 per acre, or $0.40 per box, while for those in mulch crop it is $81.68 per acre, or $0.358 per box. For all records there is a net labor cost of $85.05 per acre and $0.383 per box, while the labor cost is 37.47 per cent of the total cost of production. The net cost of maintenance for all records is $39.97, and $45.08 is the net cost for handling.

Yield per acre is the factor which has the greatest influence on the labor cost per box on the farms studied in the various regions. The higher the yield the higher the labor cost per acre but the lower the labor cost per box. It also appears that the cost of maintenance is a lower percentage of the total labor cost on those farms where the average yield is high than where it is low.

COSTS OTHER THAN LABOR.

Costs other than labor include two kinds of costs, material and fixed. Material costs include such items as manure, spray materials, seed, boxes, nails, paper, etc., while fixed costs refer to overhead charges, which are little influenced by the size of the crop. Fixed costs include equipment charge, apple-building charge, taxes, water rent, insurance, and interest on investment.

The average price per ton of manure is $1.50, and the average amount applied annually per acre is 1.48 tons, making a yearly cost of $2.22 per acre, or $0.01 per box for manure. Spray materials are charged at the regular price paid by most growers, which is $6.50 per barrel for lime-sulphur, $0.07 per pound for arsenate of lead paste, $0.01 per pound for lime, and $0.075 per pound for copper sulphate or "bluestone." Dry lead arsenate costs $0.175 per pound.

Alfalfa seed is charged at the rate of $0.18 per pound and clover at $0.20 per pound. As they are sown only occasionally, there is a very small annual charge for this item,

Shooks cost $0.095 per box, or $0.103 for the boxes made up, the contract cost for making being usually $0.80 per hundred. Paper and nails cost $0.039 per box. There is thus a total cost for boxes, including paper and nails, of $0.142 per finished box.

On the farms studied the total material costs amount to $42.80 per acre, or $0.192 per box. This is 18.86 per cent of the total annual cost of production.

In the fixed charges, which make up 43.67 per cent of the total annual cost of production, certain items are considered which many growers do not take into account, the principal charge being interest on investment. This, however, is a proper charge, as it is a factor

which ofter determines the success or failure of a great many fruit growers. It is an actual cash expense to the grower who has a mortgage on his place.

The equipment charge for these farms is $6.50 per acre annually. It is made up of depreciation, upkeep, interest, and taxes on equipment. Only the spray rig is charged entirely to the orchard, charges for all other machinery being apportioned according to the relative extent to which it is used for work on the bearing orchard and on other crops. A 25 per cent annual charge is used for equipment other than the spray rig, consisting of 11 per cent depreciation, 8 per cent interest, 5 per cent upkeep, and 1 per cent taxes. The spray rig cost also amounts to about 25 per cent, but is made up somewhat differently. The total annual equipment or machinery cost is $6.50 per acre, or $0.029 per box. This is practically $0.03 per box.

The building charge is the annual charge for apple buildings, such as packing sheds or tents. This amounts to $3.27 per acre, or $0.014 per box. Many growers have very inexpensive packing sheds, but there are a few who have a very large investment in such buildings. In such instances the cost is very high. Only average conditions are considered here, and expensive packing sheds are not the rule.

Taxes are high in Hood River Valley, as in many other Northwest sections. The average annual tax per acre in the case of the 54 apple orchards is $8.19, or $0.036 per box. The orchard's share of fire insurance is $0.33 per acre, or $0.0015 per box.

Water rent amounts to $2.62 per acre for those who irrigate. This amounts to $1.56 for all records, or $0.007 per box.

Interest on investment in apple orchard, the largest item entering into the cost of production, makes up 55.85 per cent of the material and fixed costs and 34.9 per cent of the total annual cost of production on the farms studied. This cost is figured on an average investment of $990.74 per acre at 8 per cent and an average yield of 222 boxes per acre. The interest charge per acre is $79.26 and the charge per box is $0.357. This interest cost has been fully discussed under investment.

TABLE XX.—*Material and fixed costs (54 farms).*

Item.	Clean-culture; 30 records; yield, 218 boxes.			Mulch-crop; 24 records; yield, 228 boxes.			All records; 54 records; yield, 222 boxes.			
	Cost per acre.	Cost per box.	Per cent of total cost.	Cost per acre.	Cost per box.	Per cent of total cost.	Cost per acre.	Cost per box.	Per cent of material and fixed costs.	Per cent of total cost.
Manure	$1.94	$0.0089	0.87	$2.57	$0.0113	1.11	$2.22	$0.0100	1.56	0.98
Lime-sulphur	3.17	.0145	1.42	4.11	.0180	1.77	3.58	.0161	2.52	1.58
Lead	2.33	.0107	1.05	2.61	.0114	1.12	2.45	.0110	1.73	1.08
Other spray material	2.68	.0123	1.20	2.64	.0116	1.14	2.66	.0120	1.87	1.17
Seed	.....	.....	.....	.71	.0031	.31	.32	.0014	.23	.14
Cost of made up boxes	22.45	.1030	10.07	23.48	.1030	10.11	22.87	.1030	16.12	10.08
Paper and nails	8.55	.0392	3.84	8.94	.0392	3.84	8.70	.0392	6.13	3.83
Total material cost	41.12	.1886	18.45	45.06	.1976	19.40	42.80	.1927	30.16	18.86
Equipment charge	6.34	.0291	2.85	6.71	.0294	2.89	6.50	.0292	4.58	2.86
Apple building charge	4.13	.0189	1.85	2.18	.0096	.94	3.27	.0147	2.31	1.44
Taxes	7.85	.0360	3.52	8.61	.0378	3.71	8.19	.0364	5.77	3.61
Insurance	.37	.0017	.17	.29	.0013	.12	.33	.0015	.23	.15
Water rent	.71	.0033	.32	2.62	.0115	1.13	1.56	.0070	1.10	.69
Interest on investment	74.53	.3419	33.45	85.17	.3736	36.66	79.26	.3570	55.85	34.92
Total fixed cost	93.93	.4309	42.16	105.58	.4632	45.45	99.11	.4458	69.84	43.67
Total material and fixed costs	135.05	.6195	60.61	150.64	.6608	64.85	141.91	.6385	100.00	62.53

Table XX gives a summary of material and fixed costs for both clean-culture and mulch-crop orchards. The two kinds of orchards have very nearly the same cost per box for material, namely, $0.188 for the clean-culture and $0.197 for the mulch-crop orchards. The difference come in the fixed costs, which are $0.43 per box for the clean-culture and $0.463 for the mulch-crop orchards. This difference is due mainly to the high valuation of land in mulch crop and the larger irrigation, or water tax, charge. The total material and fixed cost for all records amounts to $141.91 per acre, or $0.638 per box, or 62.53 per cent of the total annual cost of production. Of this total material and fixed cost, 30.16 per cent is for material and 69.04 per cent is for fixed cost, or the material cost is 18.86 per cent and the fixed cost 43.67 per cent of the total annual cost of production.

TOTAL COSTS.

The total of all annual costs, after crediting the orchard with hay and culls, is $226.96 per acre, or $1.021 per box, of which 37½ per cent is for labor and 62½ per cent is for material and fixed cost. If the orchards studied are separated into clean-culture and mulch-crop systems there is found to be a total cost of $222.83 per acre, or $1.022 per box, for the former and $232.32 per acre, or $1.019 per box, for the latter. Thus, although there is a difference in acre cost of $9.49, the difference in box cost is only $0.003, the yield per acre being 10 boxes more in the case of the orchards in mulch crops than in those under the clean-culture system.

TABLE XXI.—*Summary of all costs for Hood River (54 farms).*

	Clean-culture. 30 records; yield, 218 boxes.			Mulch-crop. 24 records; yield, 228 boxes.			All records. 54 records; yield, 222 boxes.		
	Cost per acre.	Cost per box.	Per cent of total cost.	Cost per acre.	Cost per box.	Per cent of total cost.	Cost per acre.	Cost per box.	Per cent of total cost.
Net cost of labor prior to harvest	$43.63	$0.2001	19.58	$35.41	$0.1554	15.24	$39.97	$0.1801	17.61
Net cost of labor for harvesting	44.15	.2025	19.81	46.27	.2029	19.91	45.08	.2031	19.86
Net cost of all labor	87.78	.4026	39.39	81.68	.3583	35.15	85.05	.3832	37.47
Material cost	41.12	.1886	18.45	45.06	.1976	19.40	42.80	.1927	18.86
Fixed cost	93.93	.4309	42.16	105.58	.4632	45.45	99.11	.4458	43.67
Material and fixed costs	135.05	.6195	60.61	150.64	.6608	64.85	141.91	.6385	62.53
Total cost	222.83	1.0221	100	232.32	1.0191	100	226.96	1.0217	100

Table XXI shows the summary of these costs and their relative percentage of the total annual cost.

On the farms studied the total annual cost of production is influenced by several factors, but the factor of greatest influence apparently is the average yield per acre. Table XXII has been prepared to show this influence. It will be seen that the larger the yield the higher the acre cost but the lower the box cost. For instance, in the case of orchards with a yield of 440 boxes there is a cost of $304.66 per acre, or $0.691 per box, while in the case of the other extreme, with a yield of 115 boxes per acre, there is a cost of $180.51 per acre, or $1.57 per box. In other words, the lowest yielding orchards have a total acre cost of $124.15 less than the highest yielding ones, but a total box cost of $0.88 more. Those orchards with a yield of 177 boxes per acre have an acre cost of $200.68, or $1.13 per box, as compared with orchards with a yield of 335 boxes and an acre cost of $282.27 or a box cost of $0.8421. As between these two groups the acre cost is $81.59 less in the case of the small yield, but $0.288 more per box.

TABLE XXIII.—*Relation of yield to total annual cost of production (54 farms).*

Yield (in boxes).	Average yield (in boxes).	Costs.										Number of records.
		Maintenance.		Handling.		Material.		Fixed.		Total.		
		Acre.	Box.	Acre.	Box.	Acre.	Box.	Acre.	Box.	Acre.	Box.	
150 and under	115	$36.33	$0.3168	$23.62	$0.2054	$24.64	$0.2143	$95.92	$0.8341	$180.51	$1.5706	11
151 to 200	177.6	34.63	.1950	35.37	.1992	34.23	.1927	96.45	.5431	200.68	1.1300	10
201 to 250	219.6	37.01	.1685	40.73	.1855	43.81	.1995	105.08	.4785	226.63	1.0320	17
251 to 300	270	45.05	.1669	59.80	.2215	51.97	.1925	101.12	.3745	257.94	.9554	7
301 to 400	335.2	53.88	.1607	74.37	.2219	60.36	.1801	93.66	.2794	282.27	.8421	6
Over 400	440.8	48.26	.1095	88.08	.1998	76.32	.1731	92	.2087	304.66	.6911	3
All records	222	39.97	.1801	45.08	.2031	42.80	.1927	99.11	.4458	226.96	1.0217	54

The handling and material costs per acre are the costs most affected by yield, but the box cost is little affected by these items. The maintenance cost is also affected by the yield. Yield is no doubt influenced in turn by the maintenance cost. The fixed cost per acre, however, remains practically the same for all yields. On this account the fixed cost per box on low yields is very much higher than where the yield is large. Thus with an increased yield the material and handling cost per box is not much reduced, but the fixed cost per box is very materially reduced, and to a lesser extent the maintenance cost. It is thus obvious that the higher the yield the less the cost per box, and that this reduced cost per box comes principally from decrease in the fixed charge per box.

The relation of size of orchard to annual cost of production is shown in Table XXIII. The slight increase in cost per box as the size of the orchard increases is due principally to decreased yield, for the yield per acre decreases as the size of orchard increases.

TABLE XXIII.—*Relation of size of orchards to total cost (54 farms)*

	Cost of production in orchards of each specified size.							
	5 acres and under (280-box yield, 4 records).		6 to 10 acres (228-box yield, 25 records).		11 to 20 acres (211-box yield, 19 records).		Over 20 acres (196-box yield, 6 records).	
	Per acre.	Per box.	Per acre.	Per box.	Per acre.	Per box.	Per acre.	Per box.
Maintenance	$63.26	$0.2252	$40.38	$0.1773	$35.77	$0.1695	$36.13	$0.1839
Handling	56.14	.1999	47.03	.2066	42.89	.2033	36.67	.1866
Labor cost	119.40	.4251	87.41	.3839	78.66	.3728	72.80	.3705
Material cost	53.94	.1920	43.60	.1915	41.15	.1950	37.68	.1918
Fixed cost	102.36	.3644	98.27	.4316	100.92	.4783	94.68	.4818
Material and fixed cost	156.30	.5564	141.87	.6231	142.07	.6733	132.36	.6736
Total cost	275.70	.9815	229.28	1.0070	220.73	1.0461	205.16	1.0441

From the results on the orchards studied it is evident that with a yield per acre as large as is the rule with the smaller orchards the larger orchards would show a marked decrease in the cost of production. In other words, with the yields the same in all cases the larger the acreage the less the cost per box. But as conditions exist in Hood River Valley, with the low yields on the larger acreages, the cost is not greatly affected by the size of orchard.

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